DME-100/100A

IFR
DME-100

MP MASTER
MA36010

45

NAVAIR LIMITED TORONTO INTERNATIONAL AIRPORT
BOX 214, MALTON POSTAL STATION, MISSISSAUGA, ONTARIO — Telephone: 416/676-4150

December 2,1976

Transports Canada
Chef De Secteur, Telecommunications,
Aeroport Int'l de Montreal
Depot regional
Route "C" Entree 16
Dorval, P.Q.

Gentlemen:

Ref: DME Test Set Calibration Program

You have been assigned a new DME 100A SN 1053 test set in place of the unit you have sent out to us for repair - DME 100 SN 105.

You will be billed the fixed calibration charge plus parts and labour as required for your old unit.

Please note the difference concerning power measurements between the DME 100A and the DME 100. If you need any information concerning this unit please contact the writer at 416-576-4150 Navair Ltd.

~~Can you please send back to us as soon as possible your set of two DME 100 manuals. DME 100A manuals are included with your new unit.~~

Yours truly,

J. Fayoux
NAVAIR LIMITED

JF/11:

CONNECT POWER MONITOR OUTPUT TO DC INPUT OF SCOPE . DO NOT USE 50 OHM FEED-THRU . ADJUST ' POWER KW ' CONTROL UNTIL THE TOP OF THE PULSE IS LINED UP WITH THE TRACE.

INSTRUCTION MANUAL

MODEL DME-100
DME GROUND STATION
TEST SET

SERIAL NOS. 101-143

MADE FOR
DEPARTMENT OF TRANSPORT
CANADA

BY

INSTRUMENT FLIGHT RESEARCH CORP. INC.
WICHITA, KS.

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SECTION I

General Information

1-1. Description of Test Set.

1-2. The DME-100 Ground Station Test is a flexible simulator of airborne interrogations of a DME-Ground Station. It is designed to provide complete operational check-out and parameter measurement of the Ground Station.

1-3. The Test Set includes complete signal generation, measurement and display systems. The crystal-controlled L-Band signal generator and PIN diode modulators provide properly shaped and spaced RF pulses to simulate airborne interrogations in various modes. The measurement capability includes transmitter peak power to 2.5 KW, the percentage of valid Ground Station replies, and receiver suppression time measurements.

1-4. TABLE 1-1

Specifications

Video Pulses:

PRF Range	50 to 5000 Hz, steady or average squitter; synchronized to lus calibrate marks.
Double Interrogation Delay	7 to 200us
Gaussian Pulse:	
Width	3.5 ± .5us
Rise and Fall Time	2.5 ± .5us
Square Pulse:	
Width	1 to 4us
Rise and Fall Time	100us
Double Pulse Spacing	12us (X ch) or 36us (Y ch), adjustable in ± .5, ± 3, ± 4, ± 5, and ± 6us steps.
% Reply (coincidence) Gate	
Delay	30 to 300us from P2
Width	1 or 2us
Meter Display	1 to 100 Percent Reply

RF Signal Generator:

Frequency Range:	
Phase Lock Mode	950 to 1220 MHz in 0.1 MHz steps; tolerance .005%
Variable Mode	Continuously variable from 950 to 1220 MHz with coarse and fine control
Modulation	Steady or Random PRF, CW, or OFF
Pulse Shape	Selectable Gaussian or Square; ON/OFF ratio > 80dB
2ND HARMONIC	>50DB AT 1GHZ SUR DME-100A S/N 1057
Residual FM	< 10 KHz in Phase Lock Mode
Spurious signals	>70dB down at ± 40 KHz from output frequency
Output Level	Continuous from -110 to -10 dBm (.7uv to 70mv) into 50 ohm
Level Flatness	± 1.5dB 950 to 1220 MHz referenced to output at 1100 MHz
Heterodyne Monitor	
Local Oscillator Range	950 to 1220 MHz
IF Output Bandwidth	100 MHz
Output Level	Approximately 60mV into 50 ohm
Peak Reply Power Measurement	
Range	50W to 2.5KW peak, 30W average
Accuracy	± 30% at 50W, ± 20% at 2KW

General:

AC Power	105 to 120 VAC or 220 to 250 VAC, 50 to 400Hz, 150 watts
Weight	36 pounds
Dimensions	7.5 inches high, 16.75 inches wide, 18.375 inches deep.

1-5. Guarantee.

1-6. Instrument Flight Research, Inc., hereinafter known as the Contractor, guarantees all mechanical and electrical parts of the equipment for a period of one year from date of installation in accordance with the terms of Contract Serial number OPS2-0481, DSS File PS. T8080-1-1169-05. Parts which have a "wear-out" failure characteristic and critical items which have a limited operating life shall not be counted as failures within the terms of the guarantee if they fail beyond their stated life expectancy; however, they shall be classed as "Given Parts" (Paragraph 1-11) and shall be subject to replacement in the same manner as other parts in the event failures occur during their stated life expectancy in accordance with Paragraph 1-12.

1-7. A "Part Failure" shall be deemed to have occured when the part has become defective, or does not have the characteristics required for the specified equipment performance when:

(a) the equipment is operating within the Service Conditions,

and

(b) the equipment is adjusted according to the manufacturer's procedures as stated in the Instruction Manual, or where the design required by the equipment specification to prevent failure by reason of misadjustment has not given the specified protection.

1-8. The Contractor shall replace or repair all "Parts" at no cost to the Department when they become defective during the guarantee period. All printed circuit boards shall be returned to the Contractor for repairs, at no cost to the Department, in the event of any Part failure on the board, or any board defect, during the guarantee. The completion of repairs to operating equipment shall not be prejudiced by any investigation with regard to failures as stated in Paragraph 1-10.

1-9. In the event that a part fails during the guarantee period, and causes damage to the equipment which cannot be readily repaired in the field, the entire assembly so damaged shall be returned to the Contractor for repair. The Department will be the sole judge of whether or not it will be practicable to repair the equipment in the field. If field repairs are practicable, the Contractor may, at his option, and with the Department's permission, undertake to make the required repair in the field.

1-10. The Contractor shall have the privilege of investigating whether failures have been caused by factors beyond his control. In addition, when the Department and the Contractor mutually agree that a failure was caused by a specific fault peculiar to a particular equipment in service, or by factors outside the conditions of Paragraph 1-7 of this

guarantee, the extent of the Contractor's responsibility shall be a matter for negotiation.

1-11. A "Given Part" is defined as a part having a specific physical and circuit location in the equipment. Parts having identical specifications but different physical and circuit locations shall be considered as different "Given Parts".

1-12. A "Given Part" shall be considered unacceptable in the circuit as designed when the number of failures in random equipments during the guarantee period equals the figure shown in Table 1, Column "C" for the respective grouping of equipments in service (Column B). The unacceptable part shall be replaced in all equipments covered by the production order, (Table 1, Column A) at no cost to the Department. The replacement of an unacceptable "Given Part" shall meet the design requirements of the circuit or the circuit shall be modified to correct the cause of failure.

Table 1 - Replacement of Given Parts

Column A	Column B	Column C
Equipment	Equipment in Service	Maximum Allowable Total Failures of a Given Part
1 to 24	1 to 8	3
	9 to 16	4
	17 to 24	5
25 and up	25 to 50	7
	50 and above	10

1-13. Service.

1-14. In all cases where service or adjustment is requested please first contact the authorized distributor giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when the failure occurred. The type number and serial number of the equipment must also be given. When writing to the authorized distributor or the factory in this respect, address

CONTRACTOR FACTORY

Instrument Flight Research Corporation, Inc
4053 Navajo Lane
Wichita, Kansas 67210, U.S.A.

AUTHORIZED DISTRIBUTOR

Navair Limited,
Toronto International Airport
Box 214, Malton Postal Station
Mississauga, Ontario
CANADA

1-15. The Distributor's Instrument Service Department will give the customer the procedure for disposition and shipping instructions. All equipment should be packed in a container suitable for shipment by commercial carriers.

1-16. Shipping Charges.

1-17. The authorized distributor will be responsible for shipping charges to and from Toronto to locations within Canada subject to contract conditions. The Contractor will pay actual shipping, brokerage, and customs cost on units which must be returned to the Contractor's Factory or service center for repair.

1-18. Instrument Identification.

1-19. The model and serial number of the equipment appears on a plate located on the rear of the case. All correspondence with the Contractor or Authorized Distributor in regard to any equipment should reference the complete model and serial number.

SECTION II
Operation

2-1. Introduction.

2-2. This section contains a description of the function of each control, connector, or indicator on the DME-100 Ground Station Test Set. The controls are identified in Fig 2-2.

2-3. Figure 2-1 is a typical interconnection diagram between the Test Set and a Ground Station.

2-4. Equipment Setup. Connect the DME-100 to the Ground Station as shown in Figure 2-1. All interconnection cables are RG-58 50 ohm coax except the RF Input/Output which is RG-213 or equivalent foam coax of the shortest practical length.

2-5. Terminate the HET MON, CAL, and PWR MON outputs in 50 ohm at the oscilloscope input to obtain accurate pulse shape and full signal bandwidth.

2-6. Front Panel Controls, Connections, and Indicators. See Figure 2-2.

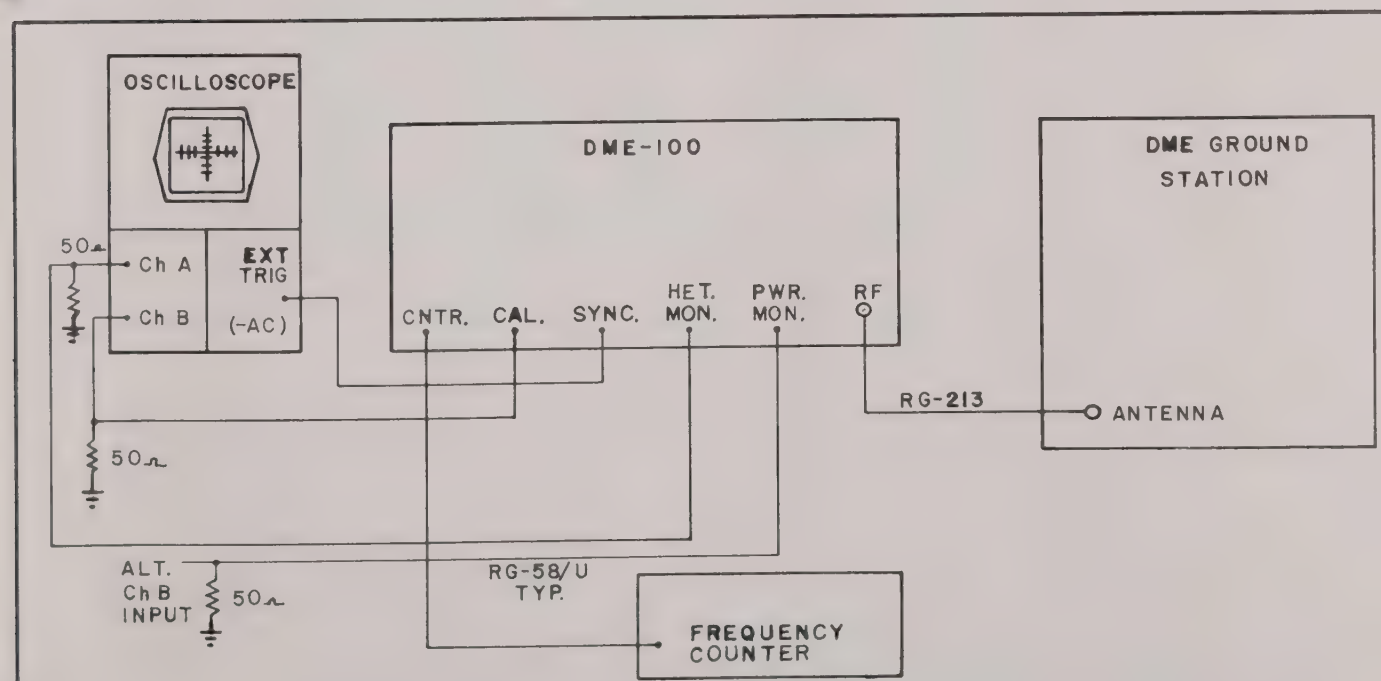
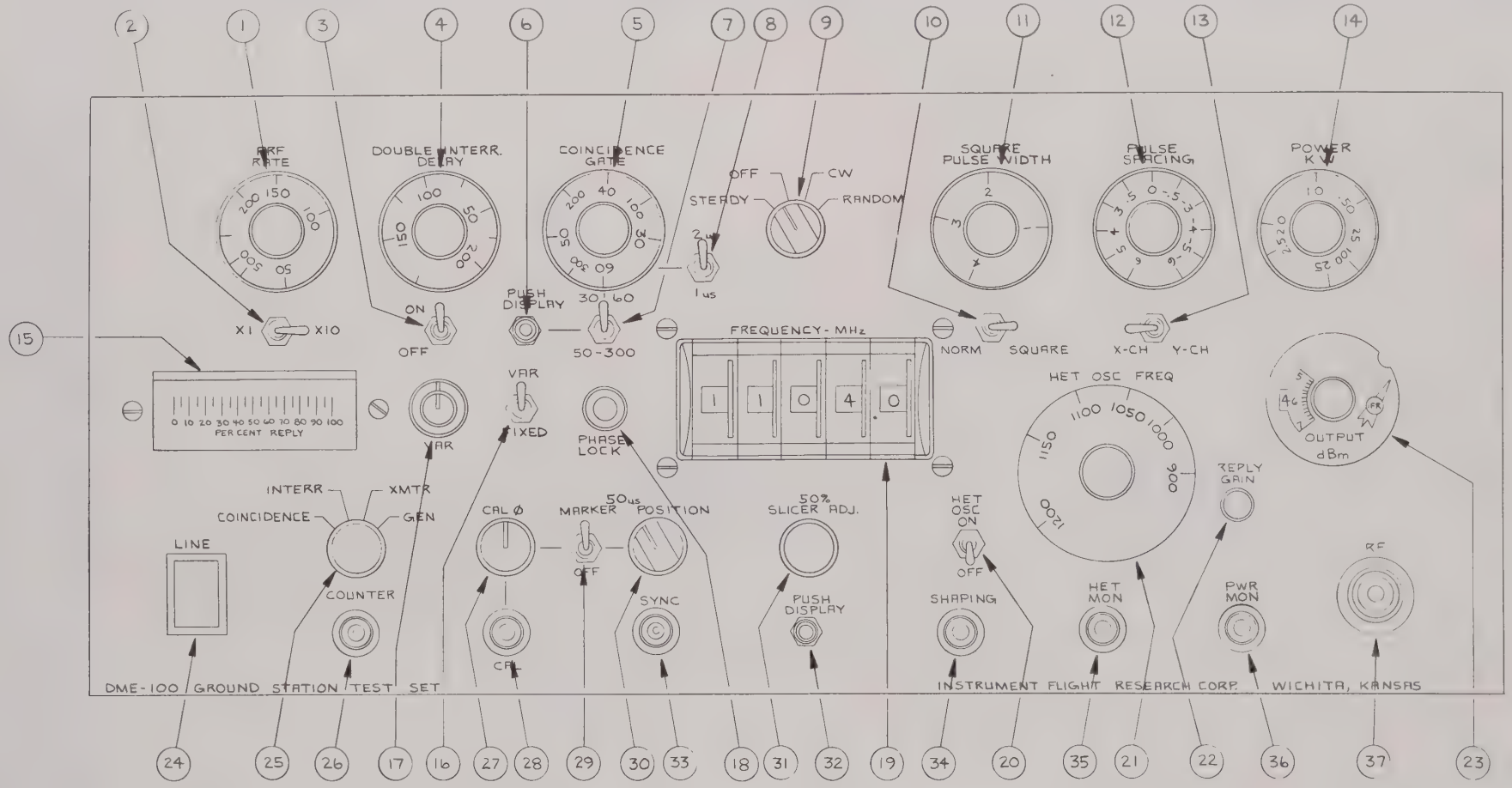


FIG. 2-1

TYPICAL EQUIPMENT INTERCONNECTION

DATE	REV	CHANGE	APP'D



NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
—	—	DME 100	—	—	—	—

APPLICATION — LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .008
ANGLES: ± 1/2°
FRACTIONS: ± 1/64 125
SURFACE ROUGHNESS
REMOVE ALL BURRS

DRAWN TM 9/5/73
CHECKED RJA 9/5/73
APPROVED RJA 9/5/73

MATERIAL —
TREATMENT —
FINISH —

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

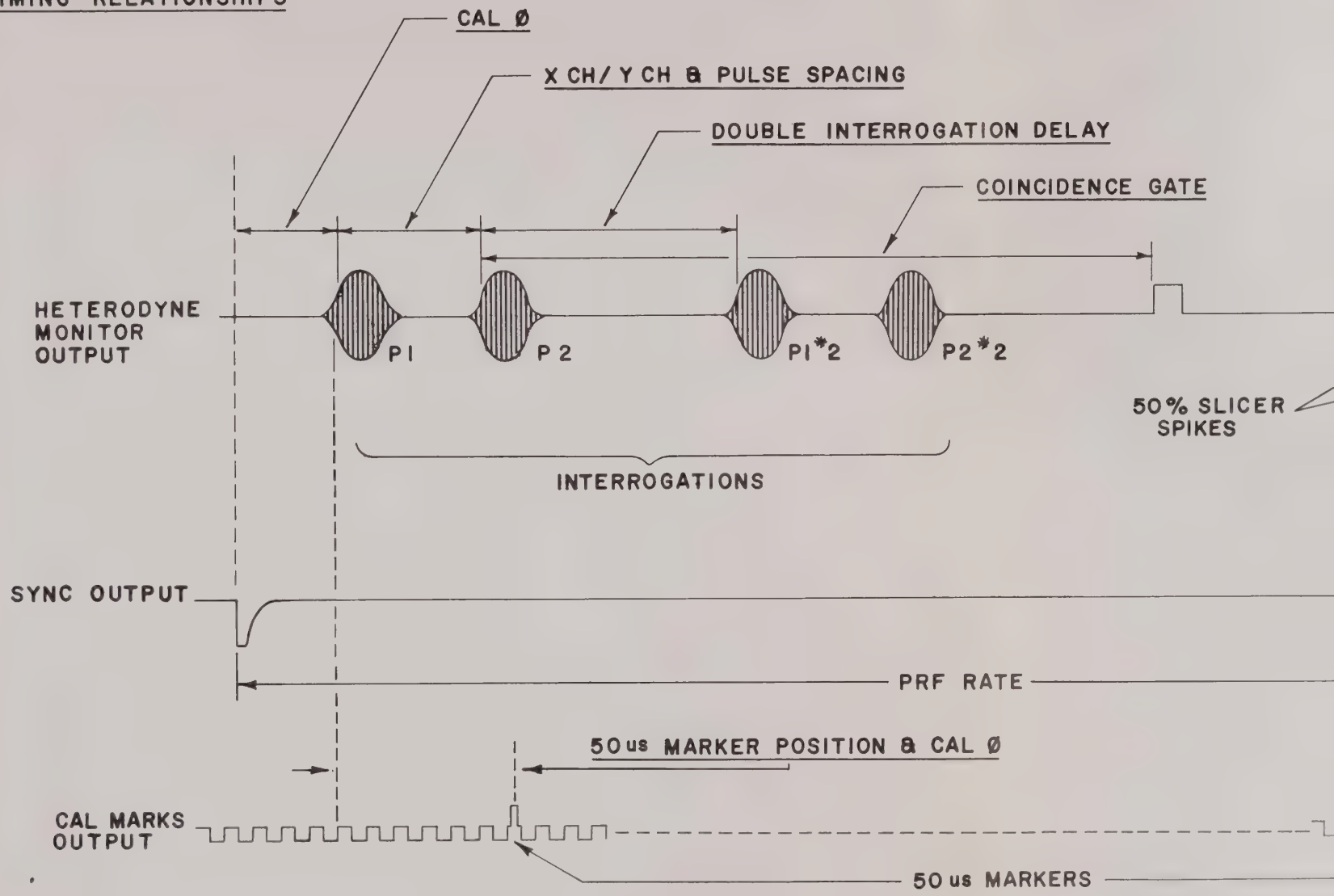
TITLE: FRONT PANEL CONTROL IDENTIFICATION DME-100

SIZE | PART NUMBER 3-18-0158 | REV

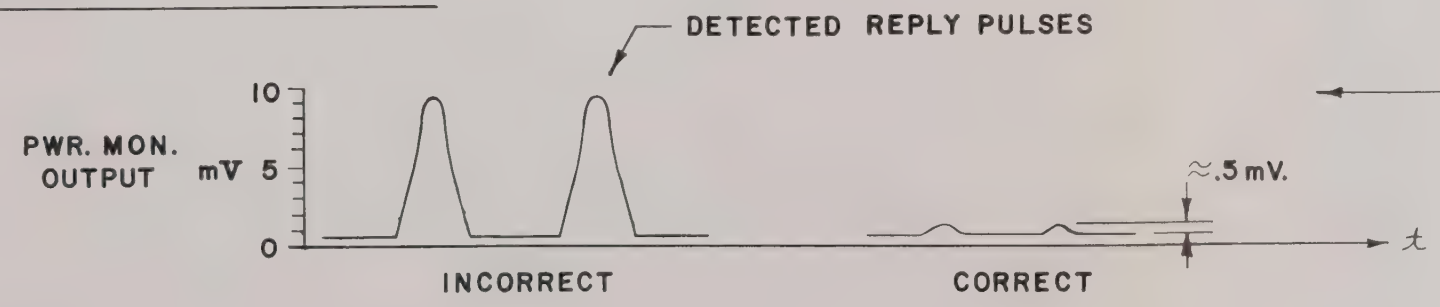
SCALE | WEIGHT — | SHEET 2 OF 2

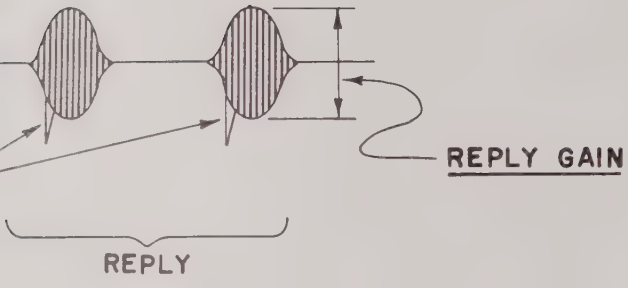
FIG. 2.2

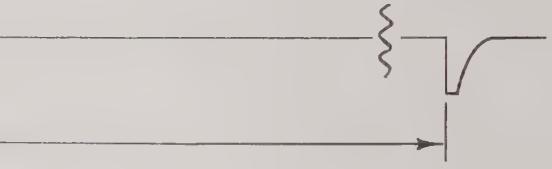
TIMING RELATIONSHIPS

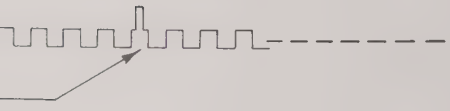


POWER KW CONTROL OPERATION



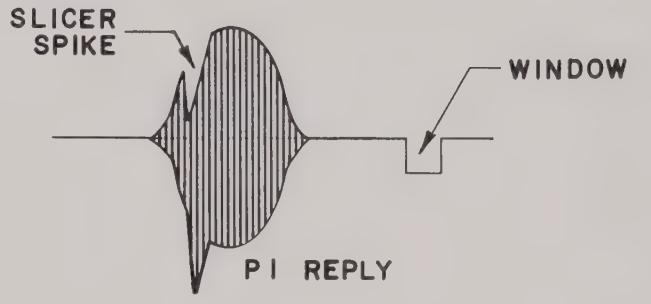






ST POWER KW CONTROL UNTIL PWR. MON.
PUT REDUCES TO ≈.5mV. POWER KW NOW
S PEAK PULSE POWER OF REPLY PULSES.

50% SLICER & COINCIDENCE GATE WINDOW ALIGNMENT



ADJUST COINCIDENCE GATE CONTROL UNTIL SLICER SPIKE IS CENTERED IN WINDOW.

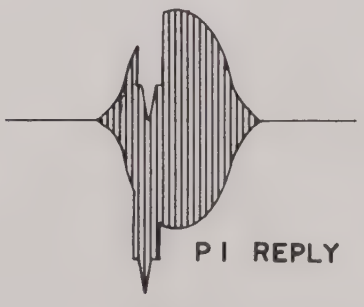


FIG. 2-2.1

TIMING RELATIONSHIPS OF FRONT PANEL CONTROLS

Figure 2-2 Front Panel Controls

1. PRF RATE. Controls frequency in Hz of interrogation pulse doublet for STEADY position of PRF MODE Switch and average frequency in RANDOM position.

2. PRF Rate Multiplier. Selects either X1 or X10 multiplier of PRF RATE control setting.

3. Double Interrogation Mode Control. In ON position, activates a second interrogation pulse doublet for each PRF cycle.

4. Double Interrogation DELAY. Controls spacing in us between the two double interrogation mode pulse doublets.

5. COINCIDENCE GATE. Controls time in us between P2 pulse and coincidence gate "window".*

6. PUSH DISPLAY. Displays the Coincidence Gate "window" position at Heterodyne Monitor output.

7. Coincidence Gate Range Control. Selects either 30-60 or 50-300us range of COINCIDENCE GATE control.

8. Coincidence Gate Width Control. Selects either a 1 or 2us "window" width.

9. PRF MODE. Controls modulation mode of RF output; e.g., STEADY or RANDOM interrogations, CW, or RF OFF.

10. Pulse Spape. Selects either NORMAL (Gaussian shaped) or SQUARE shaped interrogation pulses.

11. SQUARE PULSE WIDTH. Controls the width in us of square interrogation pulses.

12. Pulse Channel. Selects either 12us (X-Ch) or 36us (Y-Ch) for P1 to P2 pulse spacing.

13. PULSE SPACING. Deviates X-Ch or Y-Ch pulse spacing in fixed steps (us)

14. POWER KW. Measures peak power of Ground Station reply pulses when adjusted so signal at PWR MON output IS AS FOLLOWS :
INCREASE POWER KW CONTROL UNTIL THE SCOPE TRACE IS LINED UP WITH THE TOP OF PULSE.

* By viewing the HET MON output and using this control to align the window with the 50% Slicer spike, a measurement of the percent of Ground Station replies is indicated on the front panel meter.

15. PERCENT REPLY. Indicates percentage of interrogation pulses that receive a valid reply from the Ground Station.

16. Output Frequency Control Mode. Selects either continuously variable (VAR) or Phase Lock Loop (FIXED) control of RF output frequency.

17. VAR. Continuously varies RF output frequency from 940 to 1230 MHz with coarse and fine control when VAR is selected on 16.

18. PHASE LOCK. Indicates that Phase Lock has been achieved when FIXED is selected on 16.

19. FREQUENCY. Selects RF output frequency command to Phase Lock Loop circuitry when FIXED is selected on 16.

20. HET OSC ON/OFF. Applies power to Heterodyne Oscillator in Heterodyne Monitor.

21. HET OSC FREQ. Controls frequency of Heterodyne Oscillator. The control is to be set midway between the Test Set's interrogation frequency and the Ground Station's reply frequency for simultaneous display of both signals at the HET MON output.

22. REPLY GAIN. Controls level of Ground Station reply pulses at Heterodyne Monitor jack.

23. OUTPUT. Controls the peak or CW RF power level in dBm at the RF jack.

24. LINE. Applies 110 VAC power to Test Set.

25. COUNTER. Selects signal to be counted at the frequency counter jack; e.g., COINCIDENCE Gate output, INTERR- Interrogation PRF , XMTR - Ground Station reply pulses, and GEN - scaled RF Output frequency:

$$F_{GEN} = \frac{F_{out} - 900\ MHz}{100}$$ FOR DME 100

DME 100A

$$\frac{F_{out} - 800\ MHz}{100}$$

26. COUNTER Jack. Output to external frequency counter.

27. CAL Ø. Varies time between SYNC pulse and the P1 pulse to allow precise alignment of the P1 pulse and the CAL marks.

28. CAL Jack. Output for 1 MHz square waves used for timing purposes.

29. 50us MARKER/OFF. In ON positions, superimposes marker pulses 50us apart on top of the CAL square waves. The first marker pulse can be lined up with the leading edge of the P2 interrogation pulse by adjusting the 50us MARKER POSITION and CAL Ø controls. Thus aligned, the second marker pulse will occur at the P1 Reply pulse to aid the identification of the correct Reply among the squitter pulses.

30. 50us MARKER Position. Varies the position of the markers.

31. 50% SLICER ADJ. Varies the detection threshold for the reply pulses from approximately 30 to 60% of the peak pulse height.

32. PUSH DISPLAY. Displays a negative marker in the Heterodyne Monitor output at the time of threshold detection.

33. SYNC Jack. Output for -10V sync pulses.

34. SHAPING Jack. Output for Gaussian shaped pulses used to modulate an external signal generator.

35. HET MON Jack. Output of Heterodyne Monitor used to display Interrogation pulses, Reply pulses, Coincidence Gate window, and 50% Slicer Marker.

36. PWR MON. Output of peak power measurement system. When POWER KW control is adjusted so that detected Reply pulses at this jack ARE LINED UP WITH THE TRACE, its dial reads peak RF power. See Fig 2-2.1. USE SCOPE IN DC MODE/DO NOT USE 50 OHM FEED-THRU.

37. RF. 50 ohm RF output/input port that is connected to Ground Station antenna cable.

SECTION III
THEORY OF OPERATION

3-1. INTRODUCTION.

3-2. This section contains an overall explanation of circuit theory. Refer to the block diagrams and circuit schematics in Section IX while reading this section.

3-3. RF Block Diagram. Refer to Fig 3-1. RF Block Diagram.

3-4. RF Output Section. The L-Band RF is generated by a voltage controlled oscillator in a frequency band of 950 to 1225 MHz. Output power of the voltage controlled oscillator (VCO) is approximately 300mW. The RF output is applied to a 40dB Isolator and then to a RF Leveler Block. A hot carrier diode senses the RF level within the RF Leveler Block and gives a negative output voltage proportional to RF power.

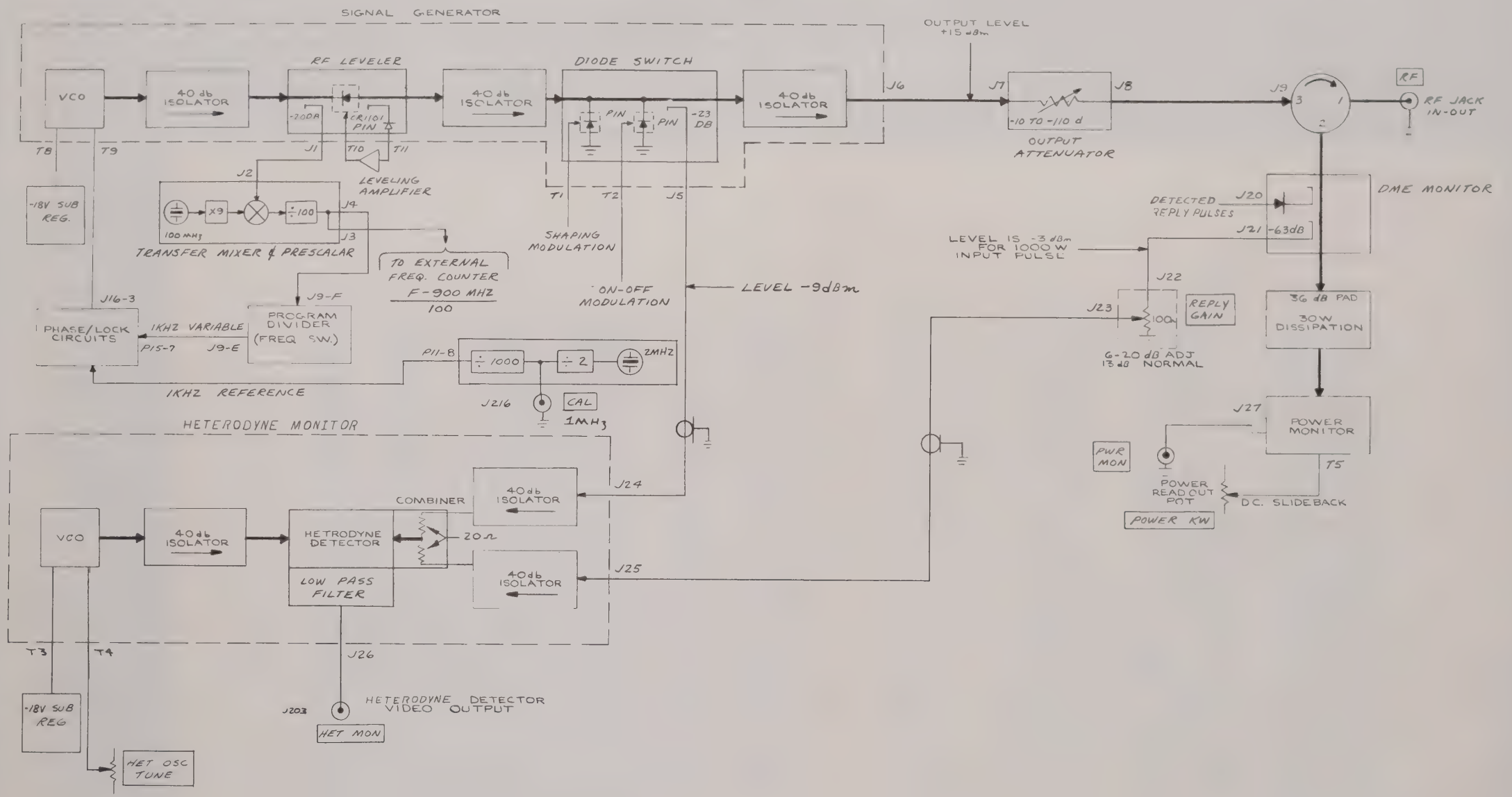
3-5. The diode output is applied to an RF Leveling Amplifier which compares the detected voltage to a reference voltage. The amplifier output is a variable voltage from 0 volts to some negative value. The more negative the level becomes the more the series diode, CR1101, is turned on, and greater amounts of RF can pass from the isolator to the Diode Switch module. Bias voltage for the VCO is supplied by a Bias Regulator located on the Phase Lock Board.

3-6. RF power applied to the Diode Switch module passes through two shunt pin diode modulators. The first, a shaping section, is used as to form Gaussian-shaped pulse pairs ("NORMAL" pulse mode) and is driven from a shaping amplifier on the Phase Lock Board.

3-7. Immediately following is an ON/OFF section switched either full ON or OFF by a driver on the Main Circuit Board. Insertion loss in the ON state is 2 to 3dB and more than 80dB in the OFF state. This section is held ON for the duration of each NORMAL pulse and is OFF in between pulses thus establishing the 80dB pulse ON to OFF signal level ratio. For the SQUARE pulse mode the shaping section is held ON and the ON/OFF section is driven by a square pulse from it's driver. During CW mode, both switch sections are held OFF.

3-8. The Output Attenuator is a capacitive piston type operated by a 10-turn counter turning a leadscrew with 10 turns per inch. One inch of piston travel equals approximately 100dB attenuation. The attenuator characteristics are nonlinear at settings from maximum output to -30dB, and become very linear from -30dB to maximum attenuation available. Thus, the power output range of 0 to -20 dBm is not calibrated with respect to the dial reading, and the -20 to -100 dBm range is calibrated.

DATE	REV	CHANGE	APP'D



NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		DME 100				

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .008
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

MATERIAL
TREATMENT
FINISH

DRAWN DATE: JJG 7/27/73
CHECKED DATE: RJM 7/27/73
APPROVED DATE: RJM 7/27/73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: RF BLOCK DIAGRAM DME 100

SIZE: C | PART NUMBER: 3-18-0040 | REV
SCALE | WEIGHT | SHEET 1 OF 1

FIG. 3-1

3-9. RF signals from the Output Attenuator pass through a circulator to the RF Input/Output jack which is connected to the DME Ground Station antenna cable.

3-10. Frequency Control Section. A portion of the VCO output power is directionally coupled from the RF Leveler Block to the Transfer and Prescaler Block.

3-11. In the Transfer and Prescaler Block is a 100 MHz, crystal-controlled oscillator. The output is applied to a snap diode which generates rich harmonics of the 100 MHz input. Two tuned line cavities pick off the 900 MHz harmonic and filter out all others. The 900 MHz output of the tuned lines is presented to a mixer diode along with the VCO output. The mixer output will be a signal of very low level ranging from 50 MHz to 320 MHz (950 MHz - 900 MHz; 1220 MHz - 900 MHz).

A counter driver amplifies the Mixer output to a level capable of operating IC counter in the Prescaler.

3-12. A divide-by-100 Prescaler consisting of two ÷ two stages and two ÷ five stages reduces the Mixer frequency to 0.5 MHz to 3.2 MHz. The Prescaler output is buffered and presented at the front panel COUNTER output connector for external counter use, and is also applied to the Programmed Divider.

3-13. The FREQUENCY switch receives the Prescaler output and further divides the frequency to achieve an output of exactly 1 KHz. The division ratio necessary to divide any input frequency (from 500 KHz to 3.2 MHz) to 1 KHz is selected by a set of thumbwheel from panel switches commanding a Programmed Divider.

3-14. The 1 KHz from the Programmed Divider is applied to the Phase Lock Board for phase comparision to a reference 1 KHz. To generate the reference 1 KHz, a 2 MHz crystal oscillator is divided to 1 MHz and then to 1 KHz. THe 1 MHz signal is available at the CAL output jack.

3-15. The output of the phase comparator feeds the VCO tune line thus completing the phase locked loop. Continuously variable frequency control is also available by breaking the phase locked loop with the VAR/FIXED switch and inserting a variable DC voltage on the VCO tune line. Two potentiometers vary the voltage in coarse and fine increments.

3-16. Heterodyne Detector. The Heterodyne Detector is composed of a mixer, a 950-1230 MHz Heterodyne Local Oscillator, and two isolated input ports. In operation, the HET OSC control is tuned to a frequency near the Signal Generator output, and the RF pulses coupled from the Diode Switch enter one of the mixer input ports. The difference frequencies of

these two inputs pass through the low pass filter (B.W. approximately 150 MHz) to the Heterodyne Detector monitor, HET MON, output. Thus the Signal Generator RF pulses can be displayed on an oscilloscope. The remaining input provides a means to simultaneously display incoming DME Ground Station reply pulses. These signals also mix with the Heterodyne Oscillator and the different frequencies pass through the LPF to the HET MON output jack.

3-17. RF Input Section. Reply signals from the DME ground station enter the RF IN/OUT jack and are directed towards the DME Monitor by the circulator. This line is terminated by a high power load to absorb the 2.5 KW RF pulses (30W continuous) from the ground station.

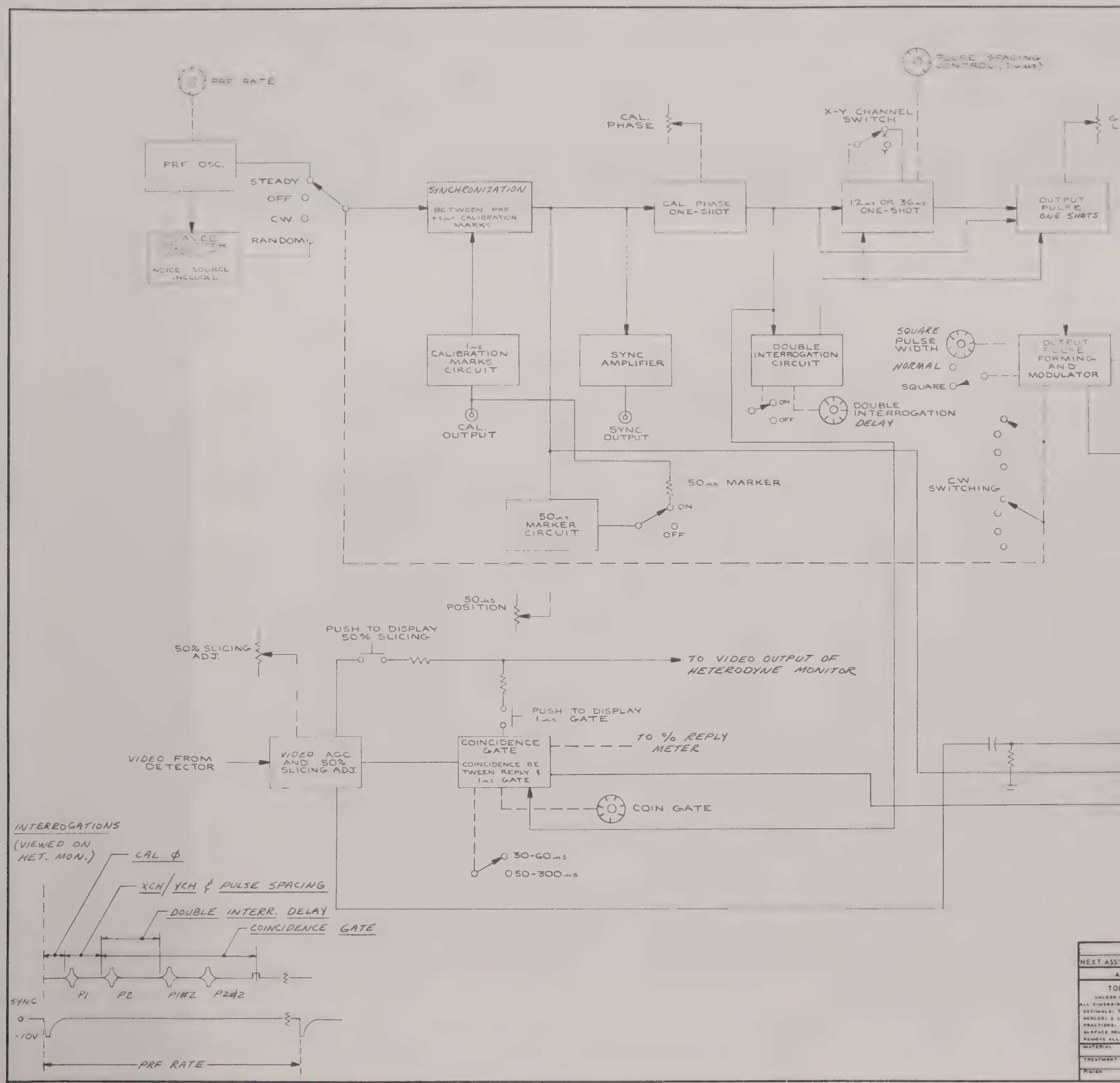
3-18. The DME Monitor is a thru-line device that picks off pulse energy, detects it, and applies positive video pulses to the Main Circuit Board. The 63dB directional coupler feeds the REPLY GAIN control which controls the amplitude of the ground station reply pulses at the HET MON jack.

3-19. Power Monitor. A 36dB directional coupler in the High Power Termination applies the input to the Power Monitor module. To measure power, input RF pulses are applied to a slide-back diode, detected across it, and the video presented at the PWR Monitor front panel connector. A DC voltage is applied to the other end of the diode which when increased progressively, back - biases the diode and decreases the video pulse amplitude at the power monitor jack. At a certain voltage the video will completely disappear into the "base line" of the scope display. The POWER kW control supplies the DC voltage, with the knob calibrated in watts corresponding to specific voltage levels. Peak power only can be measured; however, any point on the pulse wave form can be measured for power by placing that point on the base line.

3-20. Video Block Diagram. Refer to Figure 3-2, Video Block Diagram.

3-21. Output Pulse Formation. The interrogation pulse rate frequency, PRF, is determined by a temperature-compensated RC oscillator. The front panel PRF RATE and X1/X10 controls set the oscillator frequency from 50 to 5 KHz.

3-22. For the STEADY PRF MODE function, the RC oscillator output and the 1 MHz CAL pulses are applied to a synchronization circuit. The circuit "stores" each PRF output pulse until the next 1us CAL square wave negative transition; thus, the PRF RATE and CAL pulses are synchronized, and a stable oscilloscope display of both signals is possible.


PRF RATE
PRF OSC.
STEADY
OFF
CW
RANDOM
NOISE SOURCE INCLUDED
SYNCHRONIZATION
BETWEEN PRF +1ms CALIBRATION MARKS
CAL. PHASE
CAL. PHASE ONE-SHOT
X-Y CHANNEL SWITCH
12ms OR 36ms ONE-SHOT
OUTPUT PULSE ONE SHOTS
PULSE SPACING CONTROL (±5 μs)
1ms CALIBRATION MARKS CIRCUIT
SYNC AMPLIFIER
DOUBLE INTERROGATION CIRCUIT
SQUARE PULSE WIDTH
NORMAL
SQUARE
OUTPUT PULSE FORMING AND MODULATOR
ON
OFF
DOUBLE INTERROGATION DELAY
CAL. OUTPUT
SYNC OUTPUT
50ms MARKER
50ms MARKER CIRCUIT
CW SWITCHING
50ms POSITION
PUSH TO DISPLAY 50% SLICING
50% SLICING ADJ.
TO VIDEO OUTPUT OF HETERODYNE MONITOR
PUSH TO DISPLAY 1ms GATE
VIDEO FROM DETECTOR
VIDEO AGC AND 50% SLICING ADJ.
COINCIDENCE GATE
COINCIDENCE BETWEEN REPLY & 1ms GATE
TO % REPLY METER
COIN GATE
30-60ms
50-300ms
INTERROGATIONS (VIEWED ON HET. MON.)
CAL Φ
XCH/YCH & PULSE SPACING
DOUBLE INTERR. DELAY
COINCIDENCE GATE
P1
P2
P1#2
P2#2
SYNC
0
-10V
PRF RATE

3-23. In the RANDOM PRF MODE, a noise source triggers a multivibrator whose average frequency over a relatively long interval is forced to equal that set by the PRF oscillator's PRF RATE control by action of a feedback loop. The minimum time between these random pulses is clamped so no interrogations will occur during the ground station's 60us dead time. The random pulses are also synchronized with the lus CAL square wave by the synchronization circuit described above.

3-24. The coincidence circuit output is applied to the SYNC output connector and the Calibrate Phase mono stable multivibrator. The CAL Ø control allows adjustment of the calibration marks with respect to the interrogation pulse to allow precise alignment of the leading edge of both pulses.

3-25. The first pulse of each interrogation pulse pair is produced when the CAL Ø mono stable triggers the Output Pulse monostable; the second when the X-Y channel mono stable times out and then triggers the Output Pulse mono stable. The X-Ch/Y-Ch switch thus determines either 12 or 36us respectively spacing between the two pulses. The spacing can be further varied ± 6us from the nominal 12 or 36us by using the PULSE SPACING switch.

3-26. When the DOUBLE INTERROGATION switch is ON, two sets of interrogation pulse pairs result for each CAL Ø mono stable (and SYNC) pulse. The time between pulse pairs is controlled by the DOUBLE INTERROGATION potentiometer and is measured from the leading edge of the second pulse (P2 pulse) of the first pair to the leading edge of the first pulse of the second pair.

3-27. Included in the output pulse forming and modulator circuitry is a shaping amplifier that forms Gaussian shaped pulses from the square pulses at its input when the NORM/SQUARE switch is on NORM. This signal is available at the SHAPING JACK on the front panel. The Gaussian shaped pulses are buffered and connected to the Pulse Shaping Modulation input of the Diode Switch module.

3-28. When SQUARE is selected, this circuitry locks the Shaping Modulation section full ON (it's shunt diode OFF) and switches the ON/OFF diode with square interrogation pulses of variable width as selected on the PULSE WIDTH control.

3-29. With PRF MODE in CW position, a constant ON level is applied to the Shaping Modulator. The CW position also inhibits all forms of modulation applied to the ON/OFF Modulator driver and holds it full ON (it's shunt diode OFF).

3-30. Input Pulse Handling.

3-31. 50% Slicer. Detected DME Ground Station reply pulses are applied to a video AGC amplifier which regulates the height of the detected video pulses to a constant level. These leveled pulses are applied to a differential-comparator "slicing" amplifier which generates a pulse when the video input passes through its 50% amplitude level. These comparator output pulses can be displayed as a downward spike in the Heterodyne Monitor output when the PUSH DISPLAY button is pressed. The actual threshold can be varied with the 50% SLICER ADJ control.

3-32. Coincidence Gate and Percent Reply Meter. At the leading edge of the P2 pulse, a coincidence Gate mono stable is triggered. From this point in time the mono stable "moves" a 1 or 2us coincidence gate window an amount selectable on the COIN GATE control and its 30-60/50-300us range switch. The window width is chosen with the lus/2us switch and can be displayed as a small positive square pulse in the Heterodyne Monitor output when its PUSH DISPLAY button is pressed.

3-33. When the 50% Slicer spike occurs within the Coincidence Gate window, the PERCENT REPLY meter will register the fraction of Interrogation pulses that receive a reply from the DME Ground Station. Note that the COIN GATE window has to be manually positioned over the 50% Slicer spike for the meter to function.

3-34. Counter Output. When the front panel COUNTER switch is in the INTERR position, the frequency of the RF oscillator, in either steady or noisy mode, may be counted with an external frequency counter. In the XTMR position, the detected pulses from the DME Ground Station may be counted. In the GEN position, the Signal Generator VCO frequency can be counted according to the relation:

$$\text{GEN Hz} = \frac{\text{Output Frequency} - 900\ \text{MHz}}{100}$$

In the COINCIDENCE position, a pulse is produced each time a 50% Slicer spike occurs within the Coincidence Gate window.

3-35. DETAILED CIRCUIT DESCRIPTION.

The following sections contain detailed circuit descriptions for each module or circuit board. Refer to the indicated schematics while reading these sections.

3-36. RF Signal Generator (Fig 9- 7). The 40dB Isolators are all made from two circulators whose third port has been terminated. In the RF Leveler Block the 20dB coupling is produced by the 470 ohm resistor working into the 50 ohm line. Terminal T10 is connected to a current sink formed by the negative voltage at the output of the Leveling Amplifier, X303 on the Phase Lock Board. L1100 and L1101, C1100 and C1101 block RF from leaking through the leveler control line; and L1102 is a DC ground return for the control current. CR1100 samples the RF level and produce a negative DC level which is filtered by C1103, L1104, and C1104.

3-37. The two diode switch sections are made up of dual T-network diode switch circuits. When the control line is positive, the switch elements positioned as CR1102 and CR1104 conduct through L1106 and L1108 respectively and the diodes become a low impedance to RF. Diodes positioned as CR1103 are reversed biased and present a high impedance to ground. The RF signal can then pass through the T section with only a small loss. When the control line is negative, CR1102 and CR1104 are reversed biased presenting a large series impedance to the RF. CR1103 is forward biased and presents a low shunt impedance to ground. The RF is then attenuated by about 60dB for each T-network. The 667 ohm resistor at the output produces the -23dB down output at J5.

3-38. Heterodyne Detector (Fig 9-10). The output from the Heterodyne Oscillator passes through an isolator and is attenuated before it is applied as local oscillator to the detector mixer diode, CR800. The two inputs to the mixer are combined through R802 and R803. C806 allows RF to pass to the mixing diode but attenuates any mixing products that might exit through the input lines. The mixer output is applied to a multiple stage low pass filter with a 150 MHz bandwidth. This wide bandwidth allows the mixing products between the Heterodyne Oscillator and either the signal generator's interrogation pulses or the ground stations replies to be viewed simultaneously even though the products

occur 63 MHz apart. The HET OSC control varies the DC level on the tuneline to change the VCO's frequency.

3-39. The isolator near the VCO prevents it from becoming locked on either the signal generator or the ground station frequencies. The isolators on the mixer inputs prevent any signal from the Heterodyne Oscillator from entering other primary RF paths.

3-40. Transfer Mixer and Prescaler. (Figure 9-14) The 900 MHz transfer oscillator signal is generated from the 9th harmonic of the 100 MHz oscillator, Q901, a modified hartley oscillator. C908 and L905 is the collector tuned circuit, and the signal that is developed across the C906/907 voltage divider is fed back to the emitter through Y901 in series resonance. The oscillator output is then applied to the reversed biased step recovery diode CR901. The diode reverse recovery pulses are coupled to the 900 MHz half wave tuned line at about its 50 ohm point. Inside the tuned line cavity, a capacitive probe tunes the line near its quarter wave point, and a small window couples the energy into a second tuned line which further reduces unwanted harmonics.

3-41. The 900 MHz signal then acts as local oscillator for the transfer mixer, CR908. C912 is a low impedance for the RF input frequency but attenuates the mixer difference frequency that otherwise would appear at J2 and in the Signal Generator paths. At Q903 900 MHz has been subtracted from the signal generator frequency.

3-42. The prescaler driver amplifier increases the mixer output signal level to that required by the differential line receivers X901A and B. The complementary outputs of the receivers clock a high speed ÷ 2 circuit formed by the two emitter coupled flip-flops, X902A and B. The set and reset lines are arranged so that the set/reset commands are set up one half clock period before the commands are executed by the clock negative transition. An identical ÷ 2 circuit and a ÷ 5 counter, part of a TTL decade counter, follow. At Q906 the frequency has been translated down in frequency by 900 MHz and divided by 100.

3-43. DME Monitor. (Figure 9-10) The DME Monitor consists of a thruline element with a capacitive tuning stub, a coupled line feeding a detector diode and filter capacitor, and a coupled line feeding the REPLAY GAIN control.

3-44. Power Monitor Block. (Figure 9-10) The capacitive probe and 56 ohm resistor terminated the RF input port, and C1001 couples the RF pulses to the detector diode, CR1001. C1001 also acts as a DC block to the slideback voltage applied at terminal T5. A variable positive voltage from +.4 to +18V is applied to T5 with the POWER KW control until the positive level just overcomes the negative RF levels and the signal at J27 goes to zero.

3-45. Programmed Divider.(Refer to Fig 9-20 while reading this section.) X401 thru X405 are decade down counters which count down from the count entered on the thumbwheel switch array to 09000 as detected by X707. X707 then reloads the counter to the thumbwheel setting, and the cycle repeats.

The input frequency to the divider can be expressed as:

$$F_{Input} = \frac{(Fvco - 900)\ MHz}{100} \qquad (1)$$

The programmed division ratio is:

$$N - 9000 \qquad (2)$$

Where N is the thumbwheel setting. Thus the output frequency at pin E is:

$$F_{Out} = \frac{(Fvco - 900)\ MHz}{(N-9000)\ 100} \qquad (3)$$

Since the thumbwheel setting is 12,000 (dial reads 1200.0 MHz) when the VCO frequency is 1200.0 MHz, the divider's output frequency according to (3) is:

$$F_{Out} = \frac{(1200.0 - 900)\ MHz}{(12{,}000 - 9000)\ 100} = 1\ KHz \qquad (4)$$

Because the divider is part of the phase locked loop, for any setting of the thumbwheel switch the output frequency at Pin E will be 1 KHz; and 1 KHz times the prescale factor, 100, is 100 KHz, the VCO frequency increment.

3-46. X406 detects the count 090XX (X signifies any count) so that the pulses at Pin E will be 100 counts wide rather than the one count wide pulses at the output of X707.

3 47. Phase Lock Circuit Board.(Refer to Fig 9-18while reading this section.) One of the two phase detectors on the phase lock board, X304, is used as a coarse frequency adjust; the other, Q311-313 is a higher-gain fine frequency adjust.

3-48. The inputs to X304 are the 1 KHz Reference square wave signal (REF) from the Main Circuit Board connected to X304 - pin 14 and the 1 KHz pulses (VAR) from the Programmed Divider connected to X304 - pin 3. When the VAR frequency is higher than the REF frequency, the phase detector output, pin 13, becomes a current source charging C321. When VAR frequency is smaller than REF, pin 13 is a sink discharging C321. When the two frequencies are equal, pin 13 becomes

a high impedance output and C321 holds the required coarse-tune signal. Q307/308 buffer this signal, and X301 amplifies and inverts the signal. Q314/315 clamp the output at the level set on their bases plus two diode drops. The resulting coarse-tune signal is applied to the VCO tuneline via R323 and FET switch, Q310.

3-49. The fine-tune phase detector is implemented by a ramp/sample-hold phase detector, Q311-313. Q311 and C304 form a ramp beginning with the downward-going edge of the 1 KHz VAR pulse. Approximately .5ms later the downward-going edge of the 1 KHz REF squarewave turns off Q316 and turns Q312 on for approximately lus. Thus the ramp's voltage is sampled and this level is transferred to C308. Any changes in the phase angle between 1 KHz REF and VAR signals appear as immediate step level changes at the sample-hold buffer Q313. The phase change information is coupled to the VCO tuneline via C319/307, R322, and Q310. The timing sequence is shown in Fig 3-3.

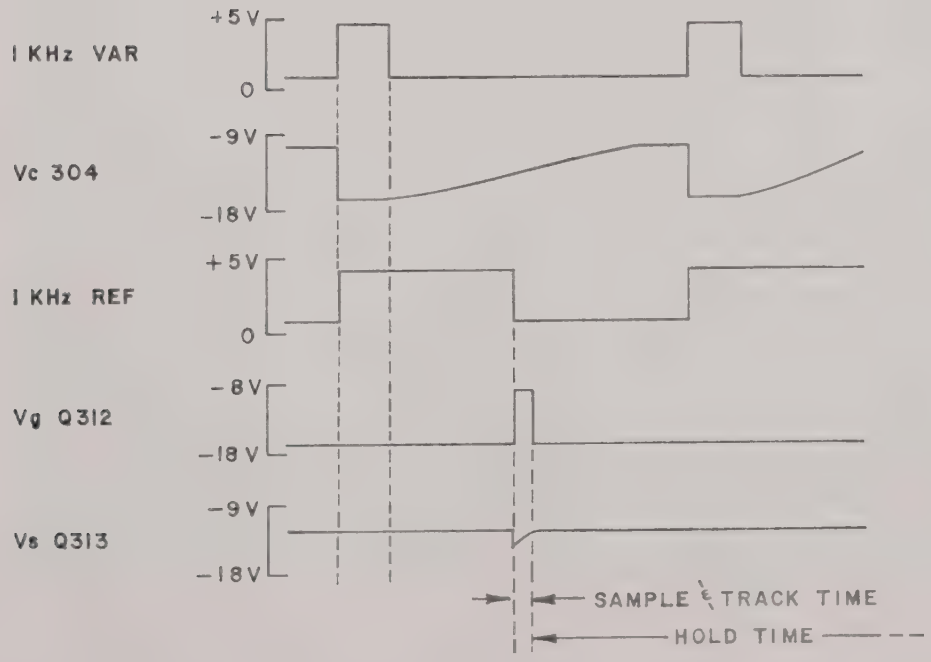


FIG. 3-3

SAMPLE-HOLD PHASE DETECTOR WAVEFORMS

3-50. When S211 is in VAR (Variable) position, the tuneline signals are controlled by R209/210, VAR, by switching Q310 off and Q309 on.

The phase lock board also contains a phase lock lamp driver, Q304-306; a shaping modulation buffer, Q319-321; a RF Leveler feedback amplifier, X303; and a -18V sub-regulator, X302, Q317/318.

3-51. Main Circuit Board. (Refer to Fig 9-16 while reading this section)

3-52. lus CAL Pulses. Q16/17 and Y1 in series resonance form a 2 MHz crystal oscillator. Oscillations at any harmonics of Y1 are prevented by C23 and R57 rolling of Q17's gain for frequencies above 2.8 MHz. The oscillator output is divided by 2 by X8A. The resulting 1 MHz square waves are available as CAL pulses on the front panel. Decade dividers X7, X6, and X5 divide the signal by 1000 to form the 1 KHz Reference square wave.

3-53. PRF Oscillator. Q1-4 form the PRF oscillator with Q1/2 being a differential comparator that senses when the exponential ramp across C1 or C2 reaches the voltage set on the PRF RATE pot. Q3/4 discharge the capacitor to reset the ramp at the end of the cycle. C5 couples the initial detection of comparator change-of-state to Q3's base turning Q3 on. C7 and Q4 form a regenerative feedback loop that provides a strong feedback signal to Q3 to insure it stays on long enough to discharge C1 or C2.

3-54. PRF and CAL Pulses Synchronization Circuit. PRF pulses differentiated by C24 and R60 and inverted by Q18 clear X8B into "armed" state. The very next negative-going transition of the lus CAL pulse toggles X8B which toggles X12. The second negative transition toggles X8B again but not X12 since it is connected in a divide-by-two configuration. The third transition toggles X8B and X12. This negative going transition of X12 starts the chain of events that produces the actual output pulses. (Note that there is a maximum of lus jitter and also a 2us delay between the PRF pulse and the synchronization circuit output for the below assumed state of QX12 prior to the PRF pulse. For the opposite assumed initial state of QX12, only the lus maximum jitter occurs on the first cycle; all other cycles follow the sequence below.) Fig. 3-4 below shows the timing sequence.

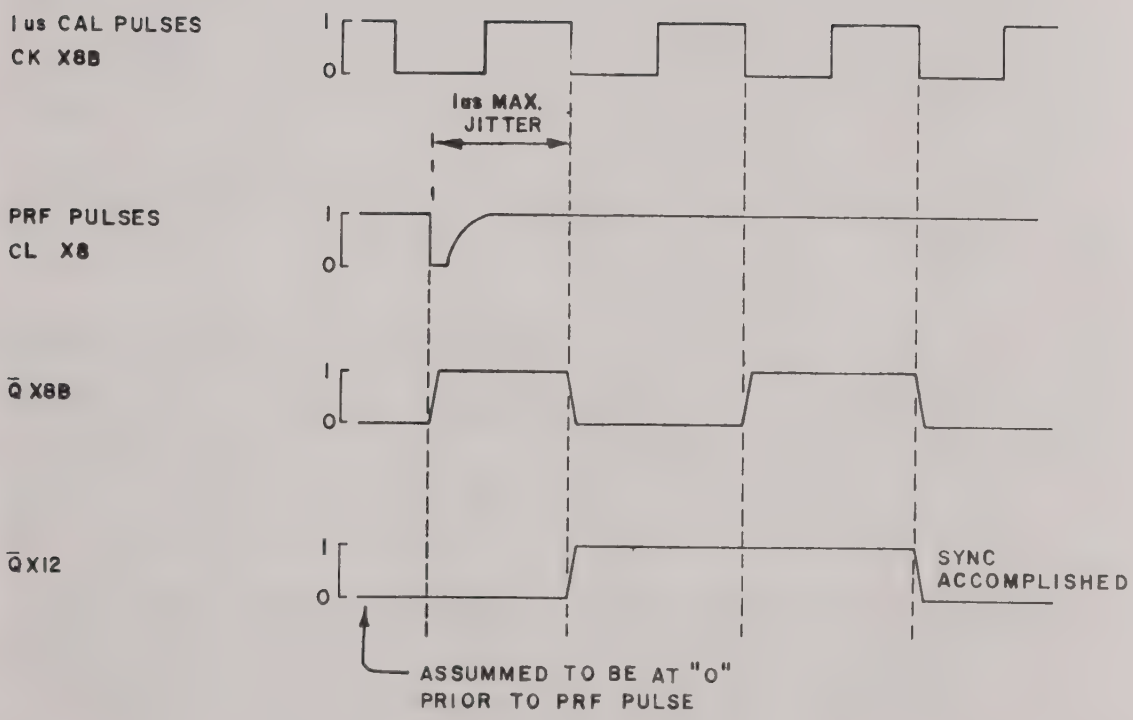


FIG. 3-4

SYNC. CIRCUIT
WAVEFORMS

3-55. The complement of the Synchronization pulse is differentiated by C71 and inverted by Q11 whose output feeds the SYNC jack.

3-56. CAL Ø Control Mono Stable. X11 allows a variable delay between the sync pulse and the initiation of the output pulse formation.

3-57. Output Pulse Mono Stables. The P1 Pulse is produced when the CAL Ø mono stable triggers the Output Pulse Mono Stable, Q19/20, through C27. The CAL Ø mono stable also triggers the X-Y channel spacing mono stable, Q14/15, through C20. When Q14/15 times out, Q19/20 is triggered again through C26 thus forming P2.

3-58. For the Double Interrogation mode, the CAL Ø pulse (start of P1) clears X3A. When Q14/15 times out (starts of P2) and toggles X3A through CR31, X3A triggers X4, Double Interrogation Delay mono stable. When X4 times out, Q19/20 is triggered through C28 forming P1 #2) and Q14/15 is triggered through C21 (forming P2 #2 after it times out).

3-59. Shaping Jack Output. Square pulses from Q19/20 are buffered by Q21. L1 and C30 form the Gaussian shaped pulses that are clamped to ground by CR30 and applied to the front panel jack.

3-60. Gaussian Shaped Pulse Formation. The Output Pulse mono stable, Q19/20, triggers the Shaping Width mono stable whose square pulse output is integrated by R110 and C48/49 to produce a triangular shaped waveform at the base of buffer transistor Q29. Q31 clamps the waveform's baseline at one diode drop below the voltage set on its base. Q30 clamps the peak level of the trangle wave to one diode drop above the voltage on its base.

3-61. Square Pulse Shape Formation. For the SQUARE pulse mode, mono stable Q41/43 is triggered through C64 and forms the P1 pulse. After the X/Y channel delay, mono stable, Q44/45, is triggered through C66, P2 is formed. The two pulses are summed at the base of Q46 and buffered by Q46/47.

3-62. 50us Marker. When the X-Y channel mono stable, Q14/15, times out (start of P2), the 50us Marker Position mono stable X9A is triggered. After it times out, X10 is triggered forming the 50us delay. X9B is also triggered by the X-Y channel mono stable through C40, and its 0.1us output pulse is summed into the CAL jack line through S213 and R83 marking the beginning of the 50us period. After 50us has elasped, X10 times out and again triggers X9B through C41. A second 0.1us pulse is superimposed on the CAL signal marking the end of the 50us period.

4-7. PERFORMANCE CHECK.

4-8. Power Supply Voltages. Measure three power supply voltages at terminal board TB1 located on the left side rail near the front panel. TB1-1 is the top most terminal.

TEST POINT	VOLTAGE
TB1-1	Ground
TB1-2	+20V (± .5V)
TB1-3	-20V (± .5V)
TB1-4	+5V (± .2V)

NOTE: The -20V supply is referenced by the +20V supply. If the +20V supply is out of tolerance, the -20V will be out also. All three supplies are protected by a current limit circuit. If a near zero voltage is measured, check for a short circuit between any supply buss and ground.

4-9. Interrogate Rate.

1. Connect a frequency counter to COUNTER jack and measure Interrogation PRF (nominal 2000 ± 60 Hz).
2. Place X1/X10 to X1 and count frequency (nominal 200 ± 6 Hz).
3. Vary PRF RATE and verify that frequency is adjustable from 50 to 500 Hz (X1) and 500 to 5000 Hz (X10).
4. Place PRF MODE to RANDOM and repeat steps 1 and 2.

4-10. Heterodyne Monitor Display.

1. Trigger an oscilloscope from SYNC jack and connect HET MON to channel A (use a 50 ohm termination at scope input). OMZ 100/100A/100B
2. View the Gaussian shaped pulses (nominal 30 to 100mV-PP at beat frequencies of 50 MHz or less).
3. Place PRF MODE to OFF and verify that interrogation pulses disappear.
4. Place PRF MODE to CW and verify HET MON display is continuous wave.

4-11. Double Interrogation.

1. Place DOUBLE INTERR DELAY switch to ON and control to 100us. Measure the spacing between P2 and P1 #2 (nominal 100 ± 10us).
2. Vary DOUBLE INTERR DELAY control and verify spacing is adjustable from 7 to 200us.

4-12. Gaussian (NORMAL) Pulse Shape.

1. Measure width of the interrogation pulses at the HET MON at the 50% points (nominal 3.5 ± .5us).
2. Measure the rise and fall times (nominal 2.5 ± .5us).

4-13. SQUARE Pulse Shape. Place NORMAL/SQUARE to SQUARE and verify that the interrogation pulses at the HET MON output are adjustable in width from 1 to 4us using the SQUARE PULSE WIDTH control.

4-14. Pulse Spacing.

1. Place X-Ch/Y-Ch to X-Ch and PULSE SPACING to 0. Measure the spacing between the 50% points of the P1 and P2 pulses (12 ± .25us). For Y-Ch position, the spacing is 36us ± .25us. (Cycles of the 1 MHz CAL pulses displayed on scope channel B can be used as an accurate time reference; the CAL Ø control can be used to line up the P1 pulse with the CAL pulses).
2. Vary the PULSE SPACING control and measure the pulse spacing (tolerance is ± .25us for each setting of the control).

4-15. Calibration Pulses and 50us MARKER.

1. Connect a frequency counter to the CAL jack and measure the frequency (1 MHz ± 50 Hz). Connect CAL to scope.
2. Place 50us MARKER to ON and verify that the two markers superimposed on the 1 MHz squarewave are 50us apart.
3. Adjust the 50us MARKER POSITION control and verify the markers move a total of 6us.

4-16. RF Output Frequency.

1. Place a small shielded probe into the test port at the front of the Transfer Oscillator (near T12) and measure the fundamental of the transfer oscillator (100 MHz ± 5 KHz).
2. Connect a frequency counter to the COUNTER jack and place COUNTER to GEN. Verify that the counter reads according to (1).

$$F_{Gen} = \frac{F\ Output - 900\ MHz}{100} \qquad (1)$$

3. Advance the FREQUENCY switch in .1 MHz steps and verify that the counter advances in 1 KHz steps.
4. Place VAR/FIXED to VAR. Rotate the coarse and fine Var controls and measure the GEN frequency (counter reading ranges from .5 MHz to 3.2 MHz as output frequency ranges from 950 MHz to 1220 MHz according to equation (1)).

3-63. 50% SLICER Circuit. Detected ground station replies at J20 are buffered by Q33 and fed to an attenuator/AGC amplifier made up of R138, the channel resistance of Q35, and amplifier Q34/37. The amplifier has an AC gain of +39 set by feedback resistors R142/143. When the peak level of the amplifier's output at the collector of Q37 is two diode drops above the voltage on Q36's base, (about 16V) Q36 conducts charging C58 from -20V towards zero volts. As the gate voltage on Q35 goes more positive, it turns Q35 on more, reducing its channel resistance and reducing the amplifiers input signal since Q35 and R138 form a voltage divider. This feedback action keeps the peak level of Q37's output constant at about +17.5 volts for wide variations in reply pulses' level at J20. The constant level pulses are connected to differential comparator, Q38/39. C59 provided regenerative feedback once the input signal at R149 exceeds the DC level set by the 50% SLICER control, R212. C60 and Q40 differentiate and invert the comparator transition and feed the HET MON output with a negative going spike at the time of transition. Since the reply pulse will have a 17.5V peak valve, the comparator trip point is set for about 7 to 10V so the comparator will detect the 50% point of the pulse waveform on its leading edge. The comparator transition at the falling edge of the reply pulse does not affect Q40 since it is a negative going transition which would tend to turn Q40 off from its already cutoff biased condition.

3-64. % REPLY GATE. At the beginning of the P2 pulse, the COINCIDENCE GATE position O.S., X1, is triggered. When X1 times out and triggers X2A, a 1 or 2us coincidence gate "window" is produced by X2A and flip-flop X3B is clocked into its Set condition. CR48 and R123 form an "and" gate so that if the 50% slicer pulse and the 1 or 2us window occur simultaneously, X3B is quickly Reset and spends only the relatively short time of 2us maximum in the Set condition. This describes the condition of a valid reply with the result the X3B is in its Reset state (Lo) except for a small Set interval for each PRF cycle. Fig.3-5 is the timing diagram.

Thus, for a valid reply (coincidence detected) Q42 is turned off for essentially all of a PRF cycle and its collector is high allowing current to flow thru M201. R160, 100% Adjust, is adjusted for a 100% meter reading when 100% Reply conditions are simulated during calibration. When a 50% slicer pulse does not occur within the 1 or 2us window, X3B remains Set after the start of a "window" pulse until coincidence is achieved either in the next or succeeding cycles. X3B also remains Set if the COINCIDENCE GATE control moves the window so the 50% slicer pulse

does not occur within the window. When coincidence is not achieved, Q42 is turned on by the Set (Hi) condition and M201 is shorted. In actual operation, the ground station will not give a 100% reply and M201's damping averages the amount of PRF cycles X3B is in the Reset (coincidence achieved) condition.

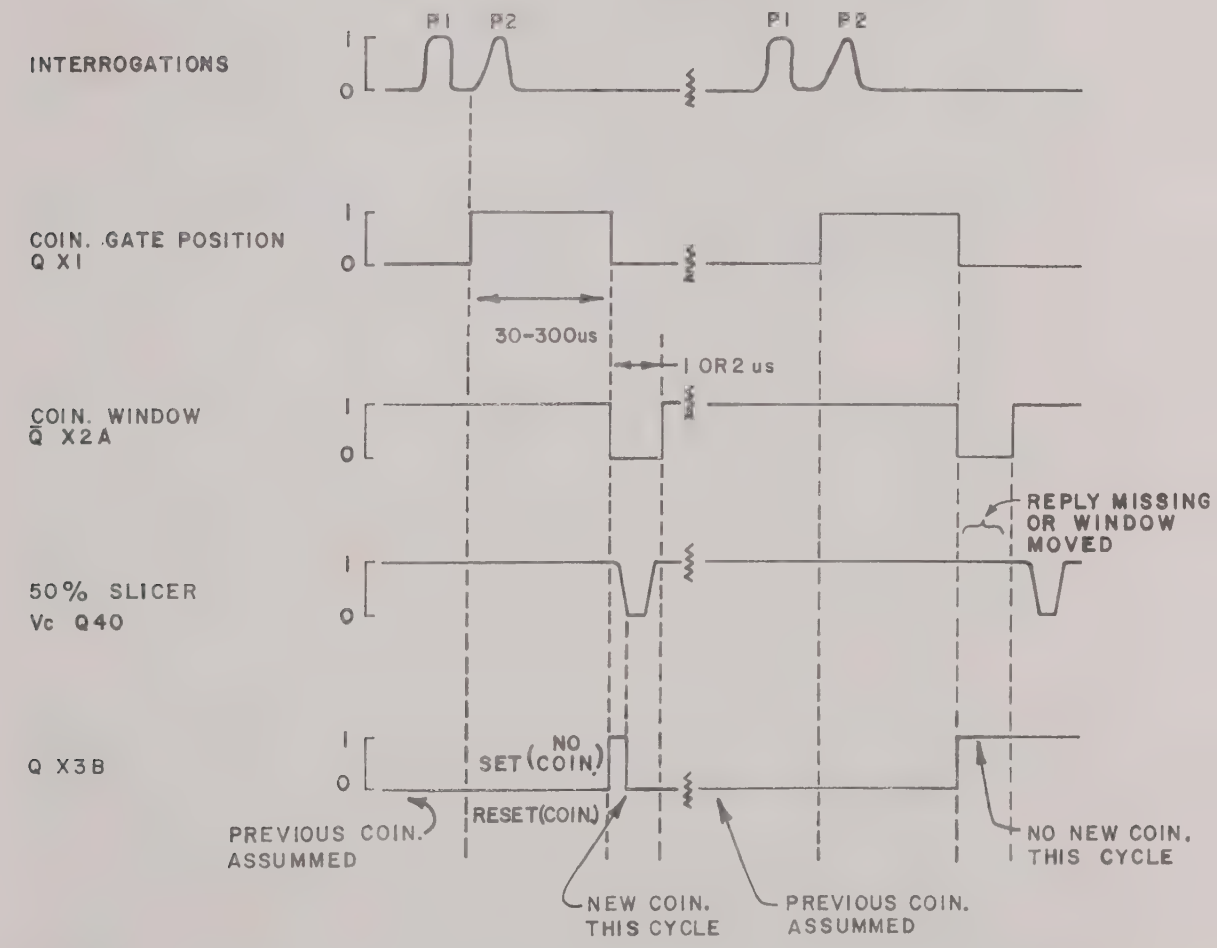


FIG. 3-5

COIN. GATE
WAVEFORMS

3-65. DISPLAY Buttons. The 50% Slicer circuit output spike is coupled into the HET MON output jack through R181, R601/602 when it's PUSH DISPLAY button is depressed. The 1 or 2us Coincidence Gate Window is coupled to the HET MON output via R603/604 when its PUSH DISPLAY button is depressed.

3-66. COINCIDENCE GATE Position. When the COINCIDENCE GATE switch is in the 30-60us position, the X1 mono stable time is determined by R205, R91, R90, C39, and C36. Q25's base-emitter junction is reversed biased for this switch position. When the 50-300us range is chosen, Q25 is operational, and since it is an emitter follower, C33 influences the mono stable timing now controlled by R205, R93, R92, C33, C39, and C36.

3-67. RANDOM PRF Regulator. When the RANDOM PRF MODE is selected the pulse frequency is random over a short period of time; but for, say, 1 second intervals, the average frequency is forced to equal the STEADY PRF oscillator, Q1/2, frequency by action of a feedback loop.

3-68. A noise source is formed by amplifying the noise across diode CR5. The positive going noise peaks at output of amplifiers Q5-7 trigger mono stable Q8/9 through C10 and CR6. When Q8/9 times out (.7 x R23 x C11 = 50us), the one shot formed by Q9/10 is triggered (.7 x R26 x C12 = 36us). While Q9/10 is timing out, Q10 is off; Q48 is on; and Q48 clamps the base of Q8 preventing it from being triggered during the Q9/10 timeout. Thus the minimum time between the random PRF pulses at Q10 is the two mono stable delays or 86us.

3-69. The constant width pulses at Q10 are integrated with a negative gain by differential integrator X13, R30, C85 R31, and C14. Steady PRF pulses of approximately the same width as the Q9/10 mono stable are formed by Q12/13, R35, R36, and C16. These are integrated with a positive gain. For the case of a train of constant width pulses, the average (integrated) DC level of the pulses as directly proportional to the PRF. Therefore the DC level at the output of X13 is proportional to the difference between the steady frequency and the average over approximately a 10ms interval of the random frequency.

3-70. If the average random frequency increases, the DC level at X13 output slews negative. This more negative level is coupled to the triggering point of Q8 through R22, and now a higher positive noise peak level (and therefore a lower probability of occurance, i.e., frequency) is required to trigger Q8. Thus the feedback loop reduces the average random PRF back to that of the Steady PRF.

SECTION IV

OVERALL PERFORMANCE CHECK

4-1. INTRODUCTION.

4-2. This section contains step-by-step procedures for checking the instrument specifications as given in Table 1-1 of this manual.

4-5. FRONT-PANEL SETTINGS.

4-6. The control settings listed below are to be used in each performance test section. Begin each test with the controls in these positions; if a control is to be set to another position, it will be listed in the procedures. After the completion of each performance check section the controls should be set back to the original front panel setting. Doing this will allow starting the performance check at any step. Set the controls as follows:

PRF RATE	200
X1/X10	X10
DOUBLE INTERROGATION DELAY	OFF
COINCIDENCE GATE 30-60/50-300 1us/2us	200us 50-300us 2us
PRF MODE	STEADY
NORMAL/SQUARE	NORMAL
PULSE SPACING	0us
X-Ch/Y-Ch	X-Ch
VAR/FIXED	FIXED
FREQUENCY	1030.0 MHz
COUNTER	INTERROGATION
50us MARKER	OFF
HET OSC	ON
HET OSC FREQ	1020 MHz
OUTPUT	-15 dBm

TABLE 4-1

Recommended Test Equipment:
Performance Check and Calibration

Type	Required Characteristics
D.C. Voltmeter	Voltage: 1V to 20V
Oscilloscope	Voltage: 5mv to 20V Bandwidth: 75 MHz
2-50 Ohm Loads	50 Ohm Oscilloscope terminations on BNC-Tee Connectors for HET MON and PWR MON signals
Frequency Counter	1 MHz and 100 MHz, ± .001%
RF Power Meter	950 - 1220 MHz -35 to -5 dBm
Calibrated L-Band Receiver	950 - 1220 MHz -110 to -20 dBm
L-Band Pulsed Power Source	1050 - 1150 MHz, 500 to 1000W Peak Able to be triggered from SYNC jack and approximately a 100us delay from trigger to output.
L-Band Mixer and Local Oscillator	1030.0 MHz crystal controlled Local oscillator

4-17. RF Output Level. Place PRF MODE to CW and measure the power at the RF jack using a power meter or a calibrated receiver. (± 1.5dB from -22 to -87 dBm over the 950 to 1220 MHz range).

4-18. RF On/Off Ratio.

1. Place PRF MODE to CW and using a power meter adjust the output for a level of -10 dBm
2. Place PRF MODE to OFF and using a calibrated receiver measure the remaining output at the RF jack (nominal -90 dBm or less). <-94 db. DME100A S/N 1057 AT 1000MHz.

4-19. Heterodyne Oscillator Range Bandwidth

1. Place PRF MODE to CW and FREQUENCY to 950 MHz.
2. Adjust HET OSC FREQ for zero beat on the HET MON oscilloscope display.
3. Place FREQUENCY to 1220 MHz and adjust HET OSC FREQ for zero beat.
4. With HET OSC FREQ adjusted for zero beat, deviate the FREQUENCY setting 10 MHz and verify that the HET MON display decreases less than 3dB.

4-20. Display and measurement of DME Ground Station Signals.

1. Connect the RF jack to the antenna connector of a DME Ground Station. Adjust HET OSC FREQ for maximum interrogation and reply signal level at the HET MON oscilloscope display.
2. Verify that the reply pulse level displayed on the oscilloscope is adjustable using the REPLY GAIN control
3. Connect the oscilloscope to the PWR MON jack (use 50 ohm termination at scope) and measure the peak power of the reply pulses using the POWER KW control. (Accuracy ± 30% at 50W and ± 20% at 2 KW).
4. Depress the 50% SLICER ADJUST DISPLAY button and verify that the negative going pip is superimposed onto the HET MON output at the point the reply pulses cross through their 50% amplitude points. Adjust the 50% SLICER ADJUST control to move the pip through 50% point of the reply pulse.
5. Depress the COINCIDENCE GATE DISPLAY button and 2us window is displayed as a positive going pulse at the HET MON output.
6. Using the COINCIDENCE GATE control, move the 2us window to coincide with the 50% SLICER pip. Verify that the % REPLY meter reads the average percent of ground station replies to the DME-100 interrogations.

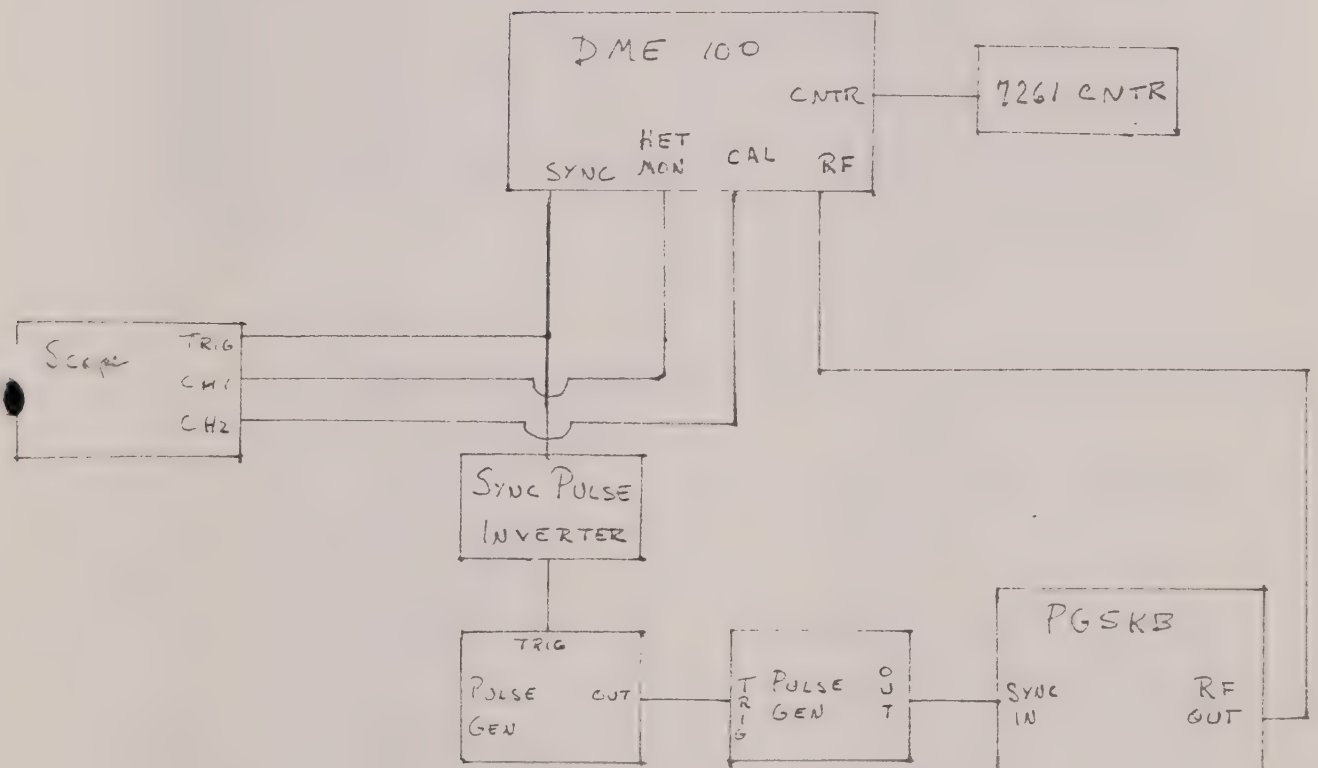
4-21. COUNTER Jack.

1. Connect the Ground Station to the RF jack. Align the Coincidence Gate window with the 50% Slicer pip. Connect a frequency counter to the COUNTER jack.

2. Place COUNTER to INTERR and read the interrogation rate.
3. Place COUNTER to XMTR and verify the reading is approximately 5400 Hz (twice the 2700 Hz constant reply rate since both pulses in a pair are counted).
4. Place COUNTER to COINCIDENCE and verify that the frequency equals the % REPLY meter reading times the interrogate frequency.

- % c reply 50 % coincidence check

Check - Coincidence gate 50µs
- Interrogation meter
- Coincidence meter
- Inter entre lock = Coincidence at entre for 90%
- Inter = x MTR/2
- check marker + 50µs



EXT TRIG
WIDTH 1µs
DLY = 50µs
Varier delay pour verifier Coincidence gate
PULSE: SINGLE

EXT TRIG
WIDTH 1 µs
PULSE: DOUBLE
DLY : 12µs
DLY ajuste spacing entre 2 pulses

EXT SYNC selecte
Pulse WIDTH à 3.5µs

4-85

SECTION V

CALIBRATION PROCEDURE

5-1. INTRODUCTION.

The Calibration Procedure contains steps for the adjustment of all internal controls to insure that the equipment specifications are met and that the front panel controls are calibrated. The equipment required for calibration is essentially that contained in Table 4.1, Recommended Equipment for Performance Check and Calibration Procedure. The control settings listed below are to be used in each calibration procedure section. Begin each test with the controls in these positions; if a control is to be set to another position, it will be listed in the procedures. After the completion of each calibration procedure section, the controls should be set back to the original front panel setting. Doing this will allow starting the procedure at any step. Set the controls as follows:

PRF RATE	200
X1/X10	X10
DOUBLE INTERROGATION DELAY	OFF
COINCIDENCE GATE	200us
30-60/50-300	50-300us
1us/2us	2us
PRF MODE	STEADY
NORMAL/SQUARE	NORMAL
PULSE SPACING	0us
X-Ch/Y-Ch	X-Ch
VAR/FIXED	FIXED
FREQUENCY	1030.0 MHz
COUNTER	INTERR
50us MARKER	OFF
HET OSC	ON
HET OSC FREQ	1020 MHz
OUTPUT	-15 dBm
Connect: HET MON	Scope Ch-A (use 50 ohm load at scope input).
SYNC	Scope External Trigger
COUNTER	Frequency Counter Input

5-2. CALIBRATION PROCEDURE.

5-3. Power Supply.

1. Connect DC voltmeter to TB201-2 (+20V buss) and ground. (TB201 is located on right side frame near front panel. TB201-1 is topmost terminal). Adjust R506 +20V Adjust for 20 ± .2V _____ V.
2. Verify that TB201-3 (-20V buss) measures -20 ± .2V. (The -20V supply is referenced to the +20V supply). _____ V.
3. Adjust R526 for +5 ± .1V at TB201-4 (+5V buss). _____ V.

4. Observe the power supply ripple through a 16 KHz RC low pass filter to eliminate logic noise (1K ohm series and 0.01uf to ground).

+20V ripple	2mV p-p	_____ mV p-p
-20V ripple	2mV p-p	_____ mV p-p
+5V ripple	5mV p-p	_____ mV p-p

5-4. Phase Lock Board.

1. Connect a frequency counter to the COUNTER jack. Place COUNTER switch to GEN. _____

2. Variable Limits: Place VAR/FIXED Switch to VAR. Rotate VAR coarse and fine controls to CW limit and adjust R538 (VAR Freq High) for a counter reading of 3.3 MHz_____

   Rotate VAR coarse and fine to CCW limit and adjust R537 (VAR Freq Low) counter reading of 0.4 MHz. R538 and R537 interact so procedure should be repeated. _____

3. Rotate VAR control until counter reads 1.3 MHz. Select 1030.0 MHz on the FREQUENCY switch. Observe the 1 KHz VAR pulses from the Programmed Divider at the "+" end of C303. _____

4. Coarse Phase Detector: Observe the aft end of R333. When adjusting the VCO frequency with the VAR control above a 1.3 MHz reading on the counter, the signal should flip below zero volts. When going below 1.3 MHz, the signal should flip above zero volts.

5. Fine Phase Detector: Observe the "-" end of C319 as VAR control is varied from maximum to minimum. The D.C. or average level should vary from approximately -14V to -7V. _____

6. X301 Centering: Observe signal at left end of R336 Adjust VAR so counter reads slightly above 1.3 MHz and adjust R335 (center) until signal just clamps at approximately +4V. Adjust VAR so counter reads slightly below 1.3 MHz and verify that the signal clamps low at approximately -19V. Readjust R335 slightly if necessary.

7. Fine Phase Detector Limits: Place VAR/FIXED to FIXED and select 1225.0 MHz on FREQUENCY switch. Adjust R338 (High Freq Limit) until counter reads 3.25 MHz. _____ Readjust R335 if necessary. Select 945.0 MHz on FREQUENCY switch and adjust R339 (Low Freq Limit) until counter reads 0.45 MHz _____ Readjust R335 slightly if necessary.

8. Phase Lock Lamp: Verify that PHASE LOCK lamp lights as FREQUENCY switch is varied between 950.0 to 1220.0 MHz _____

5-5 RF Generator Systems:

1. Transfer Mixer Input Power Check: Place VAR/FIXED to VAR and COUNTER to GEN. Adjust VAR coarse and fine controls until counter reads 1.3 MHz.

Disconnect and measure the RF power in the line feeding J2, Transfer Mixer Input (+3 to +10 dBm). _____dBm

2. Heterodyne Oscillator Dial Alignment: Set Controls

PRF MODE	CW
VAR/FIXED	FIXED
FREQUENCY	950.0 MHz
HET OSC ON/OFF	ON
HET OSC FREQ	950 MHz

Connect oscilloscope to HET MON jack (use a 50 ohm termination at scope input). Adjust R128 (HET VCO Low) for zero beat on oscilloscope. _____ Select 1200.0 MHz on FREQUENCY switch and 1200 MHz on HET OSC FREQ control. Adjust R130 (Het VCO High) for zero beat. _____ Select 1100.0 MHz on the FREQUENCY switch and 1100 MHz on HET OSC FREQ dial. Adjust R127 (VCO LIN) for zero beat. _____ Repeat these three steps twice because of interaction.

(N.B. Adjust pots so until HET OSC FREQ is within ± 5 MHz of the given valves at zero beat.) _____

3. RF Leveler: Select 950.0 MHz on FREQUENCY switch. Adjust R334 (RF Level) on Phase Lock Board for maximum level at HET MON display, then reduce the level 1 to 1.5 dB (reduce voltage about 10 to 15%). _____

4. Interrogation Pulse Shape: Place PRF MODE to STEADY. Sync scope from SYNC jack. Monitor the HET MON output on the oscilloscope. Adjust R113 (Shaping Amplitude) on Main Circuit Board until the leading edge of the interrogation pulses start and stop with a step. Then decrease R113 until the leading edge rounds neatly. _____

Adjust R117 (Peak Clipper) completely away from any peak clipping. Adjust R104 (Shaping Width) so that the pulse is 3.5us wide at its 50% points. Readjust R117 (Peak Clipper until slight rounding occurs on the top of the RF pulse. Readjust R104, if necessary, to keep the pulse width at 3.5us. The rise and fall times are to be 2.5 ± 0.5us and the width 3.5 ± 0.2us. _____

5. CW Level Adjust: Note the peak amplitude of the NORMAL (Gaussian) shaped RF pulse on the Heterodyne Monitor display. Place NORMAL/SQUARE to SQUARE. Adjust R193 (CW Level) on Main Circuit Board so that the amplitude of the square interrogation pulses matches that of the Gaussian shaped pulses. _____

6. Signal Generator RF Output Power Check: Place PRF MODE switch to CW. Disconnect and measure the RF power in the line feeding J7, Output Attenuator Input (+14 ± 5 dBm nominal). _____ dBm

7. Signal Generator Input to Heterodyne Monitor Check: Place PRF MODE switch to CW. Disconnect and measure RF power in the line feeding J24, Signal Generator Pulses input, on Heterodyne Monitor. (-7 ± 5 dBm nominal). _____ dBm

8. Heterodyne Monitor Output Check: The signal at the HET MON jack should be 0.03 to 0.10V p-p into 50 ohm for beat frequencies of 50 MHz or less between the FREQUENCY and the HET OSC FREQ SETTING. _____V p-p

9. RF Output Frequency Response: Place PRF MODE to CW. Place FREQUENCY to 1100.0 MHz. Using a RF power meter, adjust the OUTPUT attenuator for -30 dBm at the RF jack. Reset dial to read -30.0 dBm if necessary. _____

   Select frequencies from 950 to 1220 MHz in 50 MHz steps and verify that the output changes less than ± 1dB._____

10. RF Output Calibration: Place PRF MODE to CW and select 1100.0 MHz on FREQUENCY switch. Using a L-band receiver, adjust OUTPUT attenuator for -87 dBm at the RF jack. Reset dial to read -87.0 dBm if power is more than ± 1.5dB off. Take the following data (tolerance is ± 1.5dB from -87 to -22 dBm):

Measured Power	Dial Reading
-87 dBm	_____dBm
-50	_____
-30	_____
-25	_____
-20	_____
-15	_____
-10	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

5-6. Video Calibrations.

5-7. Steady PRF Rate.

1. Connect a counter to the COUNTER jack. Place X1/X10 to X10. Rotate PRF RATE to its maximum CW rotation. Note the frequency counter reading. Rotate the control CCW until the counter reads approximately 75 to 100 Hz below the above reading. Reset the dial so that the index is on "500" at this new frequency count. Set PRF RATE to 60 and X1/X10 to X10. Adjust R4 (600 Hz adjust) for a counter reading of 600 ± 3 Hz. Set PRF RATE to 500 and adjust R176 (5 KHz adjust) for a counter reading of 5000 ± 20 Hz. Repeat these two adjustments because of interaction. _____

2. Set PRF RATE to 500 and X1/X10 to X1. Adjust R3 (60 Hz adjust) for a counter reading of 500 ± 2 Hz. Take the following data:

Dial Setting	Measured Frequency (Steady PRF)
60 Hz	_____ Hz (± 1 Hz)
200	_____ (± 4 Hz)
500	_____ (± 2 Hz)
600	_____ (± 3 Hz)
2000	_____ (± 40 Hz)
5000	_____ (± 20 Hz)

5-8. Random PRF Rate.

1. Adjust R16 for 5V pp noise level at Q7's emitter. Set PRF RATE to 500 and X1/X10 to X10. Measure frequency at COUNTER jack. _____Hz

2. Place PRF MODE to RANDOM. Adjust R35 (Random PRF) until the counter reads within ± 10 Hz of the above measurement. _____Hz

3. Set PRF RATE to 50 and X1/X10 at X1. Place PRF MODE to STEADY and measure the frequency using a 10 second time base. _____Hz

4. Select RANDOM on PRF MODE switch and adjust R13 (Null adjust) until the counter reads within ± 0.4 Hz of the above measurement. _____Hz

5. Take the following data: PRF Rate

Dial Setting	Measured Frequency (Random PRF)
60 Hz	_____ Hz (± 1.5 Hz)
200	_____ (± 5 Hz)
500	_____ (± 10 Hz)
600	_____ (± 12 Hz)
2000	_____ (± 50 Hz)
5000	_____ (± 100 Hz)

5-9. CALIBRATE Marks Frequency: Connect a frequency counter to the CAL jack. Adjust C88 (2 MHz adjust) for a counter reading of 1 MHz ± 20 Hz. _____Hz

5-10. Double Interrogation Delay: Display HET MON output on oscilloscope. Trigger scope from SYNC jack. Place DOUBLE INTERROGATION switch to ON and control to 7us. Adjust R88 (Double Interr adjust) until the mid point of the leading edge of P1 #2 pulse follows the mid point of the leading edge of P2 pulse by 7us. _____ Place control to 200us and measure the P2-P1 #2 spacing. If the spacing is short of 200us by more than 5us, trim capacitor C31 needs to be increased. If spacing is over 200us by more than 5us, C31 needs to be decreased. If a correction was necessary, repeat steps. Take the following data:

DOUBLE INTERROGATION DELAY

Dial Setting	Measured Delay
50us	_____us (± 1us)
200us	_____us (± 5us)

5-11. Coincidence Gate:

1. Push the Coincidence Gate PUSH DISPLAY button and verify that the gate display at the HET MON display is between 5mV and 15mV _____
2. Place the 1us/2us switch to 1us and adjust R118 (1us adjust) until the gate display measures 1 ± 0.05us. _____us

   Place 1us/2us to 2us and adjust R119 (2us adjust) until the gate display measures 2 ± 0.05us. _____us
3. Place 30-60/50-300us switch to 30-60us position. Place 1us/2us to 1us. Place COINCIDENCE GATE control to 30us. Adjust R91 (30-60 adjust) until the middle of the 1us gate follows the mid point of the leading edge of P2 by 30us ± 0.2us. _____ Set the control to 60us and verify the spacing is 60 ± 0.6us. _____ If the spacing is less than 60us, the trim capacitor C39 needs to be increased, and vice versa. Take the following data:

COINCIDENCE GATE

Dial Setting	Measured Spacing
30us	_____us (± 0.2us)
60us	_____us (± 0.6us)

4. Place 30-60/50-300us switch to 50-300us. Set COINCIDENCE GATE control to 100. Adjust R93 (50-300 adjust) until the spacing is 100us. _____ Set the control to 300us and verify that the spacing is 300 ± 30us.

5-12. % Reply and 50% Slicer:

1. Zero the % REPLY meter with the set power off. Connect the L-Band pulse source to the RF jack and its trigger to the SYNC jack. (A triggered pulse generator connected to P20 would also simulate the detected reply pulses. Set the pulse width for 4us and rise-fall times for 2-3us, amplitude for 5V pp, and the position delay for 50 to 100us).
2. With the 50% SLICER ADJUST control about midway, depress the PUSH DISPLAY button near the 50% SLICER control. Verify that a negative spike occurs in the HET MON display at about the 50% point of the leading of L-Band source pulses (or the pulse generator signal). The spike amplitude should range from 2 to 6mV. _____
3. Place the 1us/2us switch to 2us and use the COINCIDENCE GATE control to center the negative spike in the 2us gate. Adjust R160 (100% adjust) until the meter reads 100% ± 0.5%. _____
4. Connect the frequency counter to the COUNTER jack. Place COUNTER switch to INTERR and note the frequency. Place switch to COINCIDENCE and verify that both measurements are identical. _____
5. Place COUNTER to XMTR and verify that the frequency is as above (double the above frequency if a double pulse generator is used to simulate replies.) _____
6. Monitor on scope Ch-B the signal at J20 with a BNC-Tee connector. Depress the PUSH DISPLAY button below the 50% SLICER control. Adjust the SLICER control and verify that the negative going edge of the slicer spike moves ± 0.25us from the mid point of the leading edge of the input pulse at J-20.

5-13. SQUARE PULSE WIDTH:

1. Place NORMAL/SQUARE to SQUARE and set SQUARE PULSE WIDTH to 1us. Adjust R191 (1us adjust #1) until P1 is 1 ± 0.05us wide as measured on the HET MON display. Adjust R192 (1us adjust #2) until P2 is 1 + 0.05us wide.
2. Set the WIDTH control to 4us. Verify that P1 and P2 are 4us wide.

5-14. X/Y CHANNEL Pulse Spacing:

1. Place PULSE SPACING to 0 and X-Ch/Y-Ch to X-Ch. Adjust R44 (12us adjust) until the P1-P2 pulse spacing at their mid points is 12 ± 0.1us.

2. Place X-Ch/Y-Ch to Y-Ch. Adjust R45 (36us adjust until the pulse spacing is 36 ± 0.1us. _____

3. Rotate PULSE SPACING to each position and verify that each spacing is within ± 0.25us (from -6us to +6us deviation). The CAL pulses may be used on scope channel B to measure the spacing.

5-15. 50us MARKER:

1. Connect CAL jack to scope Ch-B (use 50 ohm load at scope input). Place 50us MARKER to ON. Rotate the POSITION control until the first marker pulse superimposed on the CAL pulses aligns with the 50% point of the leading edge of the P2 pulse. _____ Adjust R182 (50us adjust) until the second marker pulse is 50 ± 0.1us from the first marker pulse. _____

2. Verify that: the marker pulse amplitude is 0.1 to 0.3V _____, the marker width is 0.12 ± .03us _____, and the CAL pulse amplitude is 0.4 to 0.8V. _____.

5-16. SYNC Output Check: Verify that the negative SYNC pulse amplitude is -10 ± 2V. _____ The sync width is 4 to 15us. _____

5-17. SHAPING Output: The SHAPING output has double pulse output on primary interrogation and double interrogation _____ The shaping output pulse width is 3.5us ± 0.5us _____ The positive going shaping pulses are variable in level by adjusting R78 (Gaussian Level), from 0 to 18V pulses _____ (into 2.2K load).

5-18. RF Miscellaneous

1. Power Measurement: Reset the POWER KW dial so the index is lined up with the first minor mark at the low end of the dial when the wiper voltage measures -0.15V to -0.05V_____

2. Connect the L-Band pulse source to the RF jack and its trigger to the SYNC jack. Rotate the PWR KW control to the actual measured pulse peak power and adjust R124 (PWR adjust) until video pulses (approximately 1mV) just appear at the PWR MON jack (use a 50 ohm load at the scope input). _____ Rotate the control to 2.5 KW and measure the wiper voltage. _____ (5.6V nominal)

3. REPLY GAIN Control: Check the HET MON for display of the above reply pulses on scope Ch-A. Verify that the REPLY GAIN control varies the level of these pulses from one half to double the level of the internal interrogation pulses. If the REPLY GAIN control doesn't give the required range, adjust the RF coupling by screwing in or out (to increase or decrease respectively) the BNC connector in the DME Monitor assembly, J21. Lock the lock nut when the adjustment is finished. _____

WITH ATTENUATOR SET AT -90dB ATTENUATION.

4. RF Leakage: Place PRF MODE to OFF. Connect the receiver to the RF output jack and verify that no signals above -105 dBm from 950-1220 MHz are present. _____ Move the HET OSC FREQ control through the same frequency range and verify that no signals are above 105 dBm. _____

5. Transfer Oscillator Frequency: Place a small shielded probe into the test port at the front of the Transfer Mixer (near T12) and measure the fundamental of the transfer oscillator frequency (nominal 100 MHz ± 3 KHz). Adjust the trimmer capacitor near the test port if necessary. _____ MHz.

6. Residual FM: Place PRF MODE to CW. Connect the RF jack to the RF port of the L-Band mixer and a crystal controlled 1030.0 MHz local oscillator to the mixer LO port. Select 1030.1 MHz on the FREQUENCY switch. Connect the mixer IF output to the oscilloscope. Rotate the OUTPUT control to -10 dBm. Verify that the residual FM at the mixer output is less than ± 5 KHz (less than ± 1us jitter of the 10us beat frequency period). _____ us jitter

SECTION VI

GROUND STATION TEST PROCEDURES

(Supplied by Canadian D.O.T.)

SECTION VII

DISASSEMBLY AND ASSEMBLY OF TEST SET

7-1. INTRODUCTION.

7-2. This section presents instructions for performing disassembly and reassembly of the DME-100. The test set should only be disassembled when repair is proved to be necessary. Also disassemble only as far as necessary indicated by the nature of the problem. The order of disassembly and reassembly of electronic equipment can usually be determined through observation. In addition to the simplified drawings given in this section, refer to the illustrated parts list in Section IX for detailed assembly of sub-sections.

7-3. DISASSEMBLY PROCEDURES.

A. Equipment Cabinet
   (1) Remove four screws in top cover. Slide cover to rear and off of test set.
   (2) Remove four screws in bottom cover. Slide to rear and off of test set.
   (3) Remove four screws in each side cover. Remove from test set.

B. Power Supply Regulator Board
   (1) Remove two screws near bottom edge of board
   (2) Pull down out of plug and remove from set.

C. Power Supply Regulator Transistors
   (1) Remove two screws from rear insulated transistor cover.
   (2) Unsolder the wires from each lead. Label the wires for later reassembly.
   (3) Remove two screws on appropriate transistor.
   (4) Remove transistor from rear of test set. Recover and save two insulated bushings from mounting holes in rear panel.

D. Programmed Divider Board
   (1) Remove plug from left edge of P.C. board located on the rear of the Frequency Select switch.
   (2) Using a long shanked screwdriver or similar tool, carefully pry the board from rear of Frequency Select switch while slowly working the plugs loose by carefully rocking the board back and forth. Remove from set.

E. Floor components (Figure 9- 5). To remove or service any floor components, remove the two screws at the rear corners of the Main Circuit Board. Hinge board up toward the front of the set.

(1) Transfer Mixer and Prescaler Block.
   (a) Disconnect J18, P-2, P-3, and P-4.
   (b) Remove four screws from the bottom of the block through the floor plate.
   (c) Move the block to the rear; pivot the back end up; and remove the block from the set in a verticle position.
   (d) Remove silicon grease from bottom edge of block and any extra areas on floor plate.

(2) Circulator and DME Monitor.
   (a) Disconnect P-19 from Circulator
   (b) Disconnect P-20 and P-21 from DME Monitor
   (c) Remove two flat head screws in front an back of the DME-Monitor that tie down the Circulator mounting plate to the floor.
   (d) Disconnect the N-type connectors on both the Circulator and the Monitor and remove both units.

(3) High Power Termination and Power Monitor.
   (a) Unsolder the wire connected to T5 on the Power Monitor
   (b) Disconnect P-27 from the Power Monitor
   (c) Disconnect the N-type connectors on both the High Power Termination and Power Monitor
   (d) Remove the two nuts that ties down the termination mounting plate to the floor.

(4) Phase Lock Board
   (a) Disconnect the wires connected to T1 and T2 on the Signal Generator.
   (b) Disconnect J-16
   (c) Remove the four screws that mount the Phase Lock Board

(5) Signal Generator Block. (Remove Ø Board first)
   (a) Disconnect and remove the coax cables connected to J-5, J-1, and J-6.
   (b) Remove four screws that tie the Signal Generator to the Heterodyne Monitor Block.

(6) Heterodyne Monitor Block. (Remove Ø Board and Signal Generator Block first.)
   (a) Disconnect J-14, P-24, P-25, and P-26
   (b) Remove the four screws that tie the Heterodyne Monitor to the floor.

7-4. Assembly Procedures.

7-5. In general, assembly of any component to the main chassis is the reverse order of disassembly as described in paragraph 7-3. Reference may also be made to assembly drawings in the Illustrated Parts List, Section XII.

NOTE: Reassembly of the power regulator transistors to the rear panel and of the counter block to the floor plate require the spreading of a film of silicon grease, type General Electric G-624 Silicon Dielectric Compound, or equivalent, to the component surfaces contacting the rear panel and floor plate.

A RF seal is used in the Signal Generator and Heterodyne Monitor assemblies to help prevent leakage. A simple seal can be made of solder (non-corrosive flux). This seal is to be placed between the assembly box and its cover with the solder on the outside of the screws. Make sure that there are no gaps and that the solder is completely under the cover. It may be necessary to retighten the screws due to seepage of the flux.

SECTION VIII

INSPECTION/CHECK

8-1. INTRODUCTION.

8-2. This section presents instructions to determine, by inspection, the general condition of the DME-100 and possible faults found through performance tests or normal operation.

8-3. CLEANING.

8-4. Though not always necessary, many times it is wise to clean the dust, cobwebs, etc., out of the test set prior to inspection, repair, or calibration. Some shops clean their test equipment on a regular basis such as bi-annual or annual proof-of-performance checks.

8-5. It is recommended that dust removal be done with a hand controlled dry air jet of not too high pressure (25-50 psi.). The fan blades, rotor and frame should be wiped with a lint-free cloth moistened with rubbing alcohol. The rear panel should be cleaned with a dry cloth only. The front panel may be cleaned whenever necessary with a lint-free cloth moistened with rubbing alcohol.

8-6. Care must be taken to avoid breaking wires or shorting component leads together during cleaning.

8-7. INSPECTION/CHECK.

8-8. Procedures

A. Chassis. Includes anything mechanical or made from metal. Inspect for tightness of sub-assemblies, damaged connectors, corrosion or damage to the metal surfaces, etc. Surface corrosion may indicate damage inside the affected part.

B. Capacitors. Inspect for loose mounting, body damage, case damage, leakage or corrosion around leads.

C. Jacks. Inspect all coax jacks for loose or broken parts, cracked insulation, bad contacts, etc. Do not disassemble connectors within the test set.

D. Potentiometers. Any potentiometer that feels rough when rotated or produces circuit or voltage irregularities should be checked with an ohmmeter for proper operation.

E. Resistors. Inspect all types of resistors for cracked, broken, charred or blistered bodies and loose or corroded soldered connections.

F. Printed Circuit Boards. Check connectors for corrosion and damage and the mating plugs for similar damage. Inspect all mounted components for damage including crystals and I.C.'s. The boards should be free of all foreign material. Clean with acetone if necessary.

G. Semiconductors. Inspect all diodes, rectifiers, and transistors for cracked, broken, charred or discolored bodies. Check ends of components for seals around leads.

H. Switches. Examine all toggle switches for loose levers and terminals, loose body to frame condition. The line switch contacts should not be bent nor the switch action too loose. The thumbwheel switches should have definite detents and not feel loose.

I. Transformer. Inspect the transformer for signs of excessive heating, broken or charred insulation, loose mounting hardware and any other abnormal conditions.

J. Wiring. Inspect all wiring of chassis for broken or loose ends and connections, and proper dress relative to other chassis parts. All laced wiring should be tight with ends securely tied.

SECTION IX

Trouble Shooting Sequence and Schematics

9-1. INTRODUCTION.

9-2. This section contains "diognostic trees" that will help isolate faulty circuits for several major malfunctions. Checks for proper circuit operation or signal level are made in the order in which the function at the top of each tree is developed. When a certain circuit check does not agree with either the signal levels in the "diagnostic tree" or the wave form sketches accompanying the schematic, the boxes to the right of each circuit check step identify the active components involved in each check.

The theory of operation in Section III should be consulted to determine the proper operational characteristics of the circuitry involved in each check. Start the check with the front panel controls in the following position (different control adjustments may be made for particular checks):

PRF RATE	200
X1/X10	X10
DOUBLE INTERROGATION DELAY	OFF
COINCIDENCE GATE	200us
30-60/50-300us	50-300us
1us/2us	2us
PRF MODE	STEADY
NORMAL/SQUARE	NORMAL
PULSE SPACING	0us
X-Ch/Y-Ch	X-Ch
VAR/FIXED	FIXED
FREQUENCY	1030.0 MHz
COUNTER	INTERR
50us MARKER	OFF
HET OSC	ON
HET OSC FREQ	1020 MHz
OUTPUT	-15 dBm

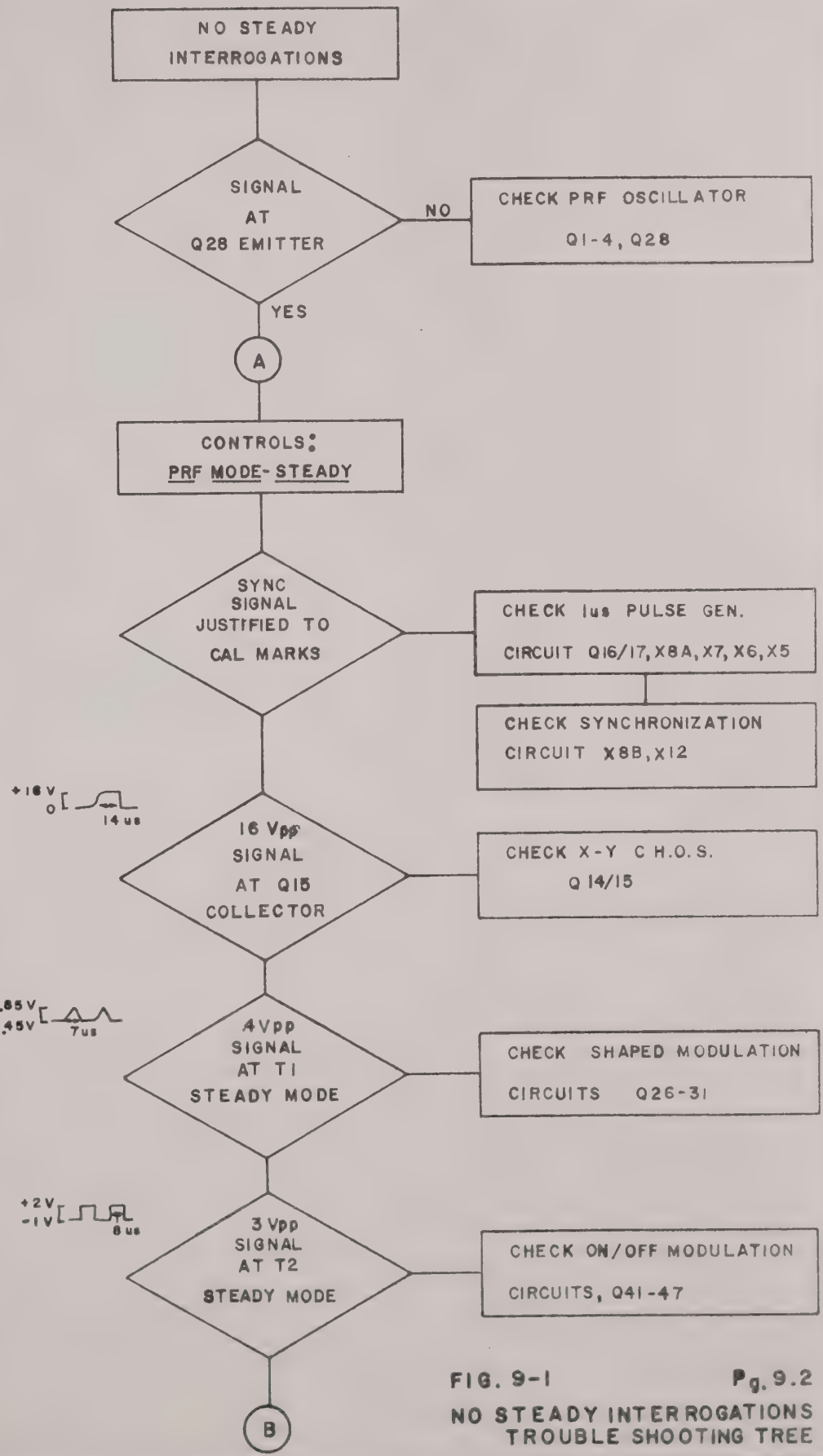


FIG. 9-1 Pg. 9.2

NO STEADY INTERROGATIONS TROUBLE SHOOTING TREE

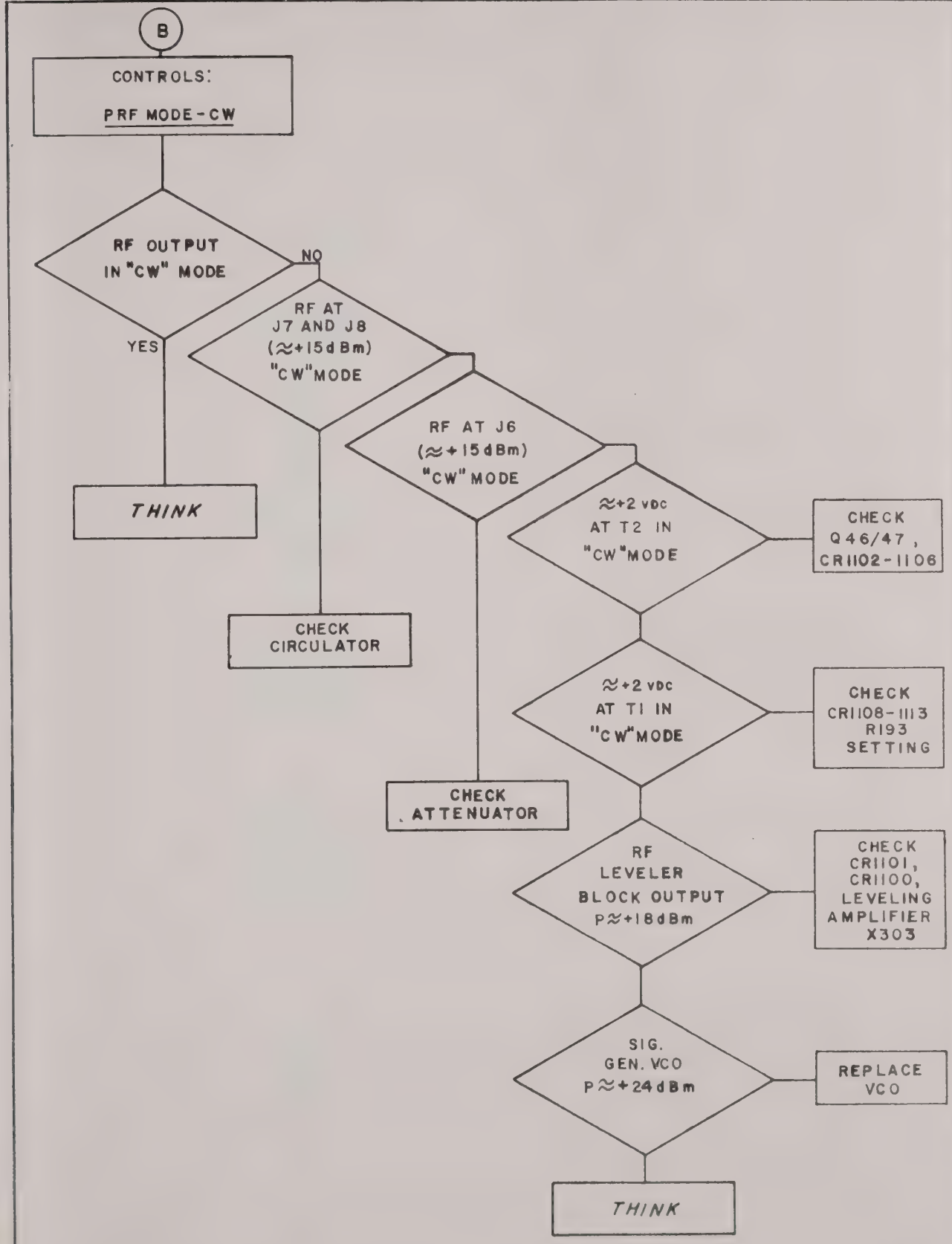


FIG. 9-1

NO STEADY INTERROGATIONS (CONT.)
TROUBLE SHOOTING TREE

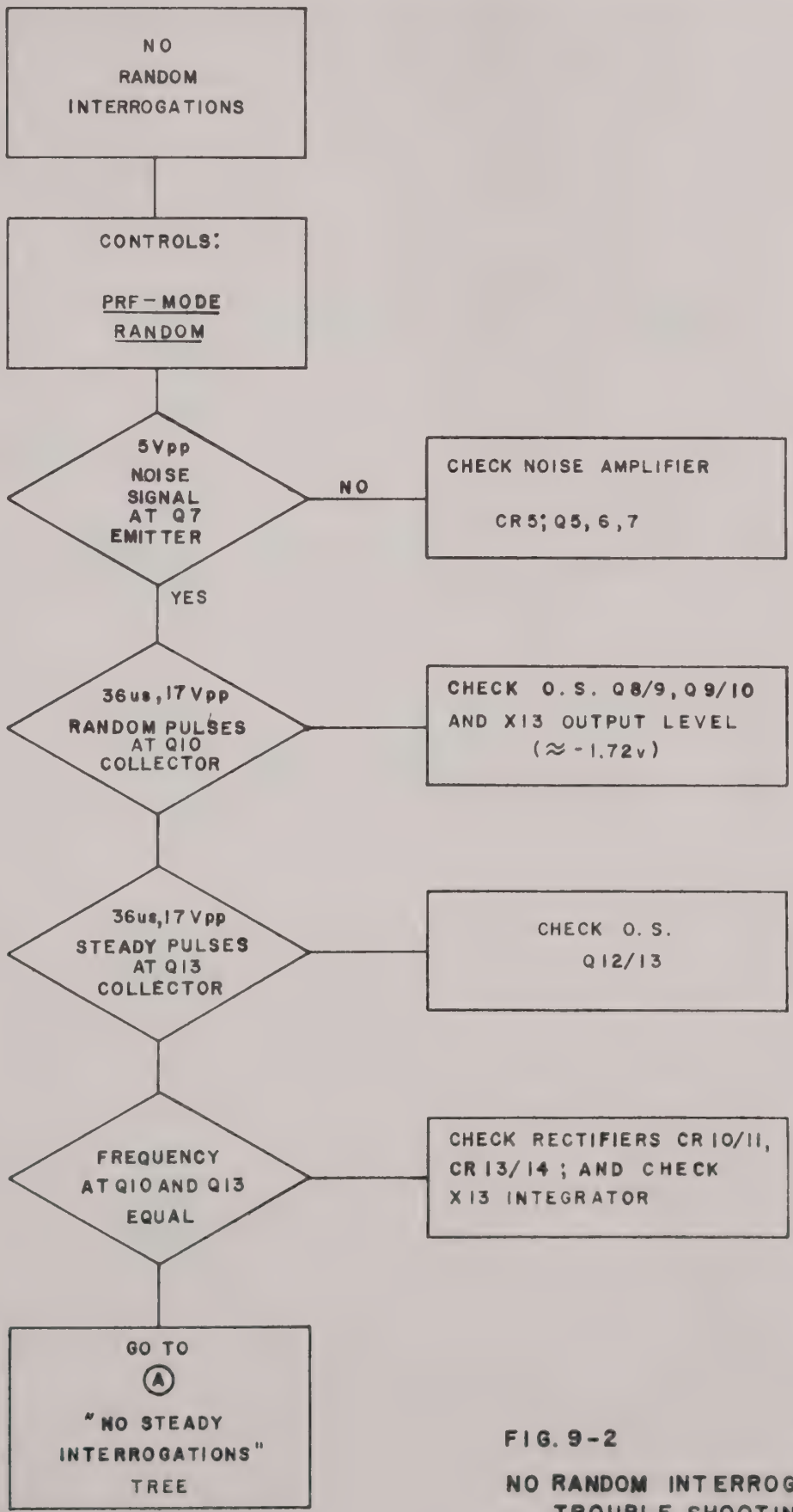


FIG. 9-2 Pg.9.4

NO RANDOM INTERROGATIONS
TROUBLE SHOOTING TREE

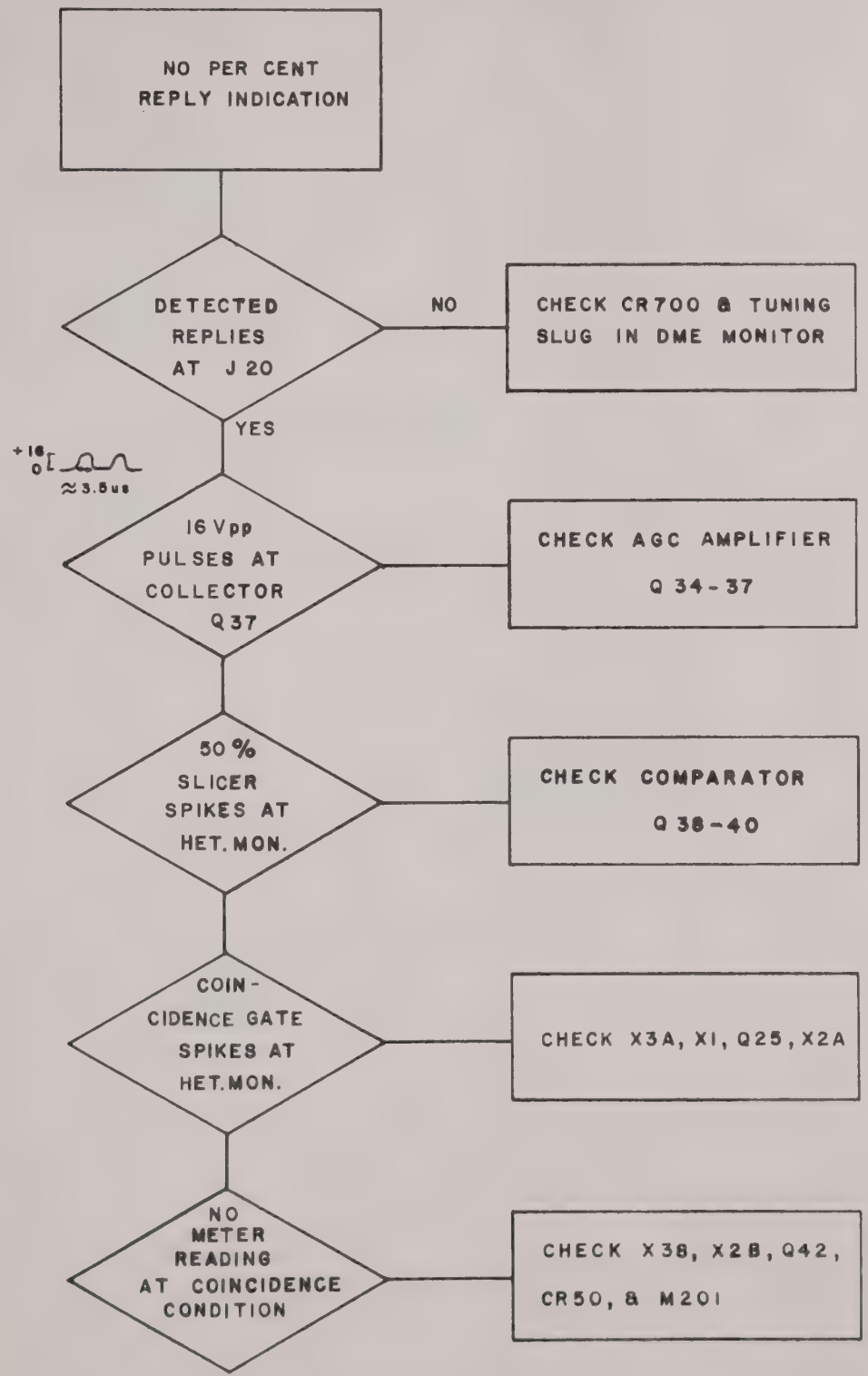

NO PER CENT REPLY INDICATION
DETECTED REPLIES AT J 20
NO
CHECK CR700 & TUNING SLUG IN DME MONITOR
YES
+16
0
≈3.5us
16 Vpp PULSES AT COLLECTOR Q37
CHECK AGC AMPLIFIER Q 34-37
50 % SLICER SPIKES AT HET. MON.
CHECK COMPARATOR Q 38-40
COIN-CIDENCE GATE SPIKES AT HET. MON.
CHECK X3A, X1, Q25, X2A
NO METER READING AT COINCIDENCE CONDITION
CHECK X38, X28, Q42, CR50, & M201

FIG. 9.3 Pg.9.5

NO % REPLY
TROUBLE SHOOTING TREE

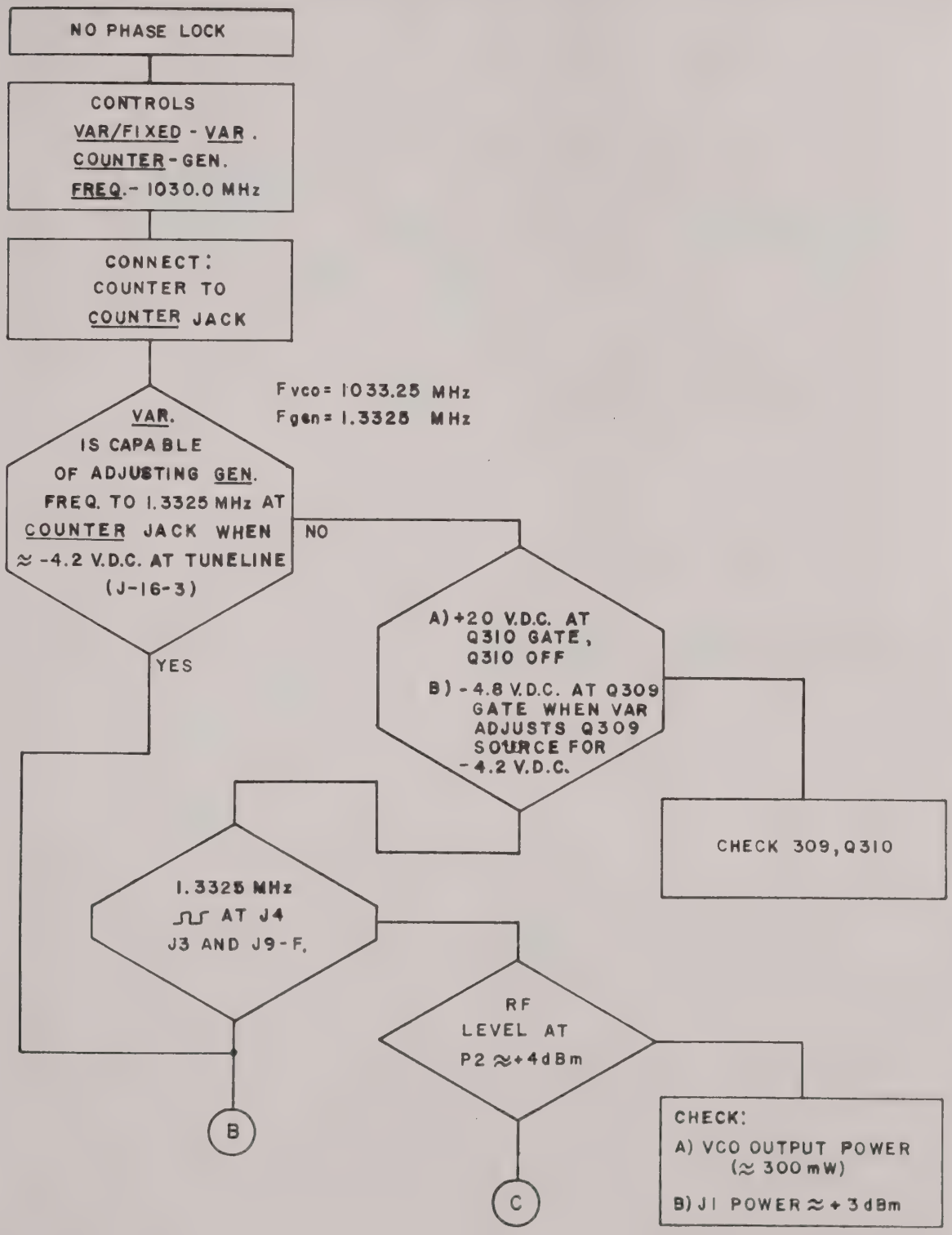


FIG. 9-4 Pg. 9.6

NO PHASE LOCK
TROUBLE SHOOTING TREE

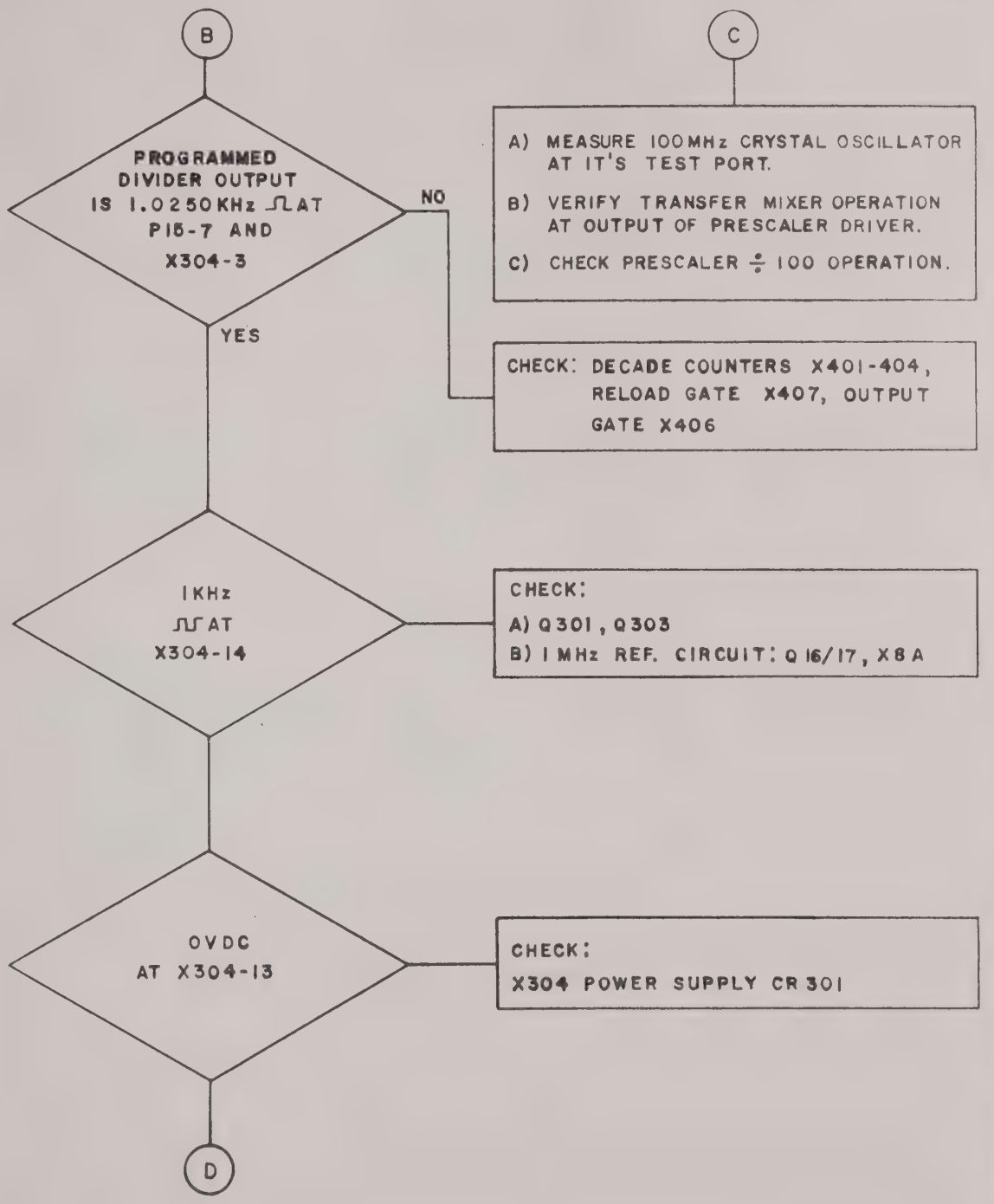

B
C
PROGRAMMED DIVIDER OUTPUT IS 1.0250KHz ⎍⎍ AT P15-7 AND X304-3
NO
YES
A) MEASURE 100MHz CRYSTAL OSCILLATOR AT IT'S TEST PORT.
B) VERIFY TRANSFER MIXER OPERATION AT OUTPUT OF PRESCALER DRIVER.
C) CHECK PRESCALER ÷ 100 OPERATION.
CHECK: DECADE COUNTERS X401-404, RELOAD GATE X407, OUTPUT GATE X406
1KHz ⎍⎍ AT X304-14
CHECK:
A) Q301, Q303
B) 1 MHz REF. CIRCUIT: Q16/17, X8A
0VDC AT X304-13
CHECK:
X304 POWER SUPPLY CR301
D

FIG. 9-4 Pg. 9.7

NO PHASE LOCK (CONT.)
TROUBLE SHOOTING TREE

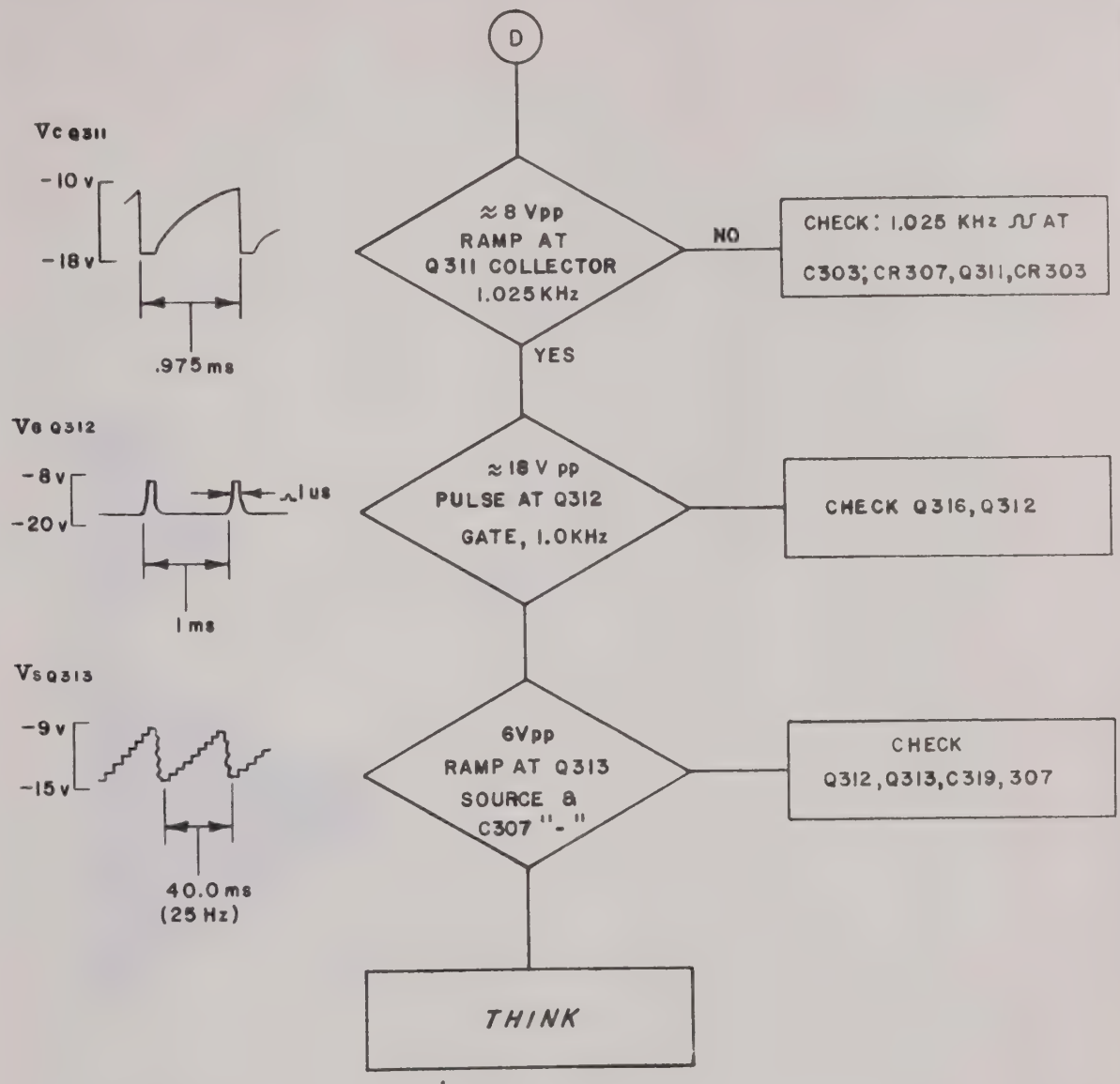


FIG. 9-4 Pg.9.8

NO PHASE LOCK (CONT)
TROUBLE SHOOTING TREE

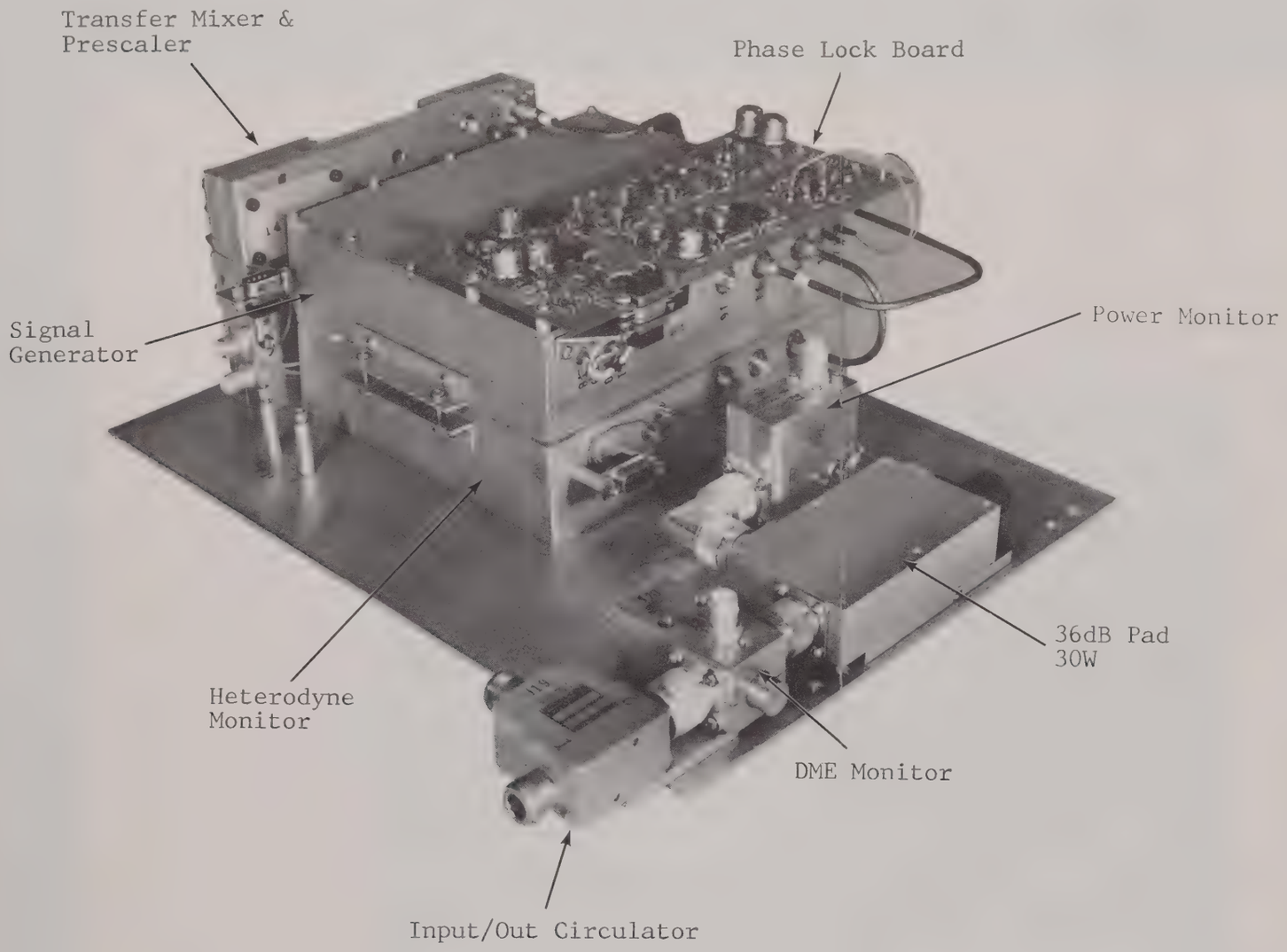
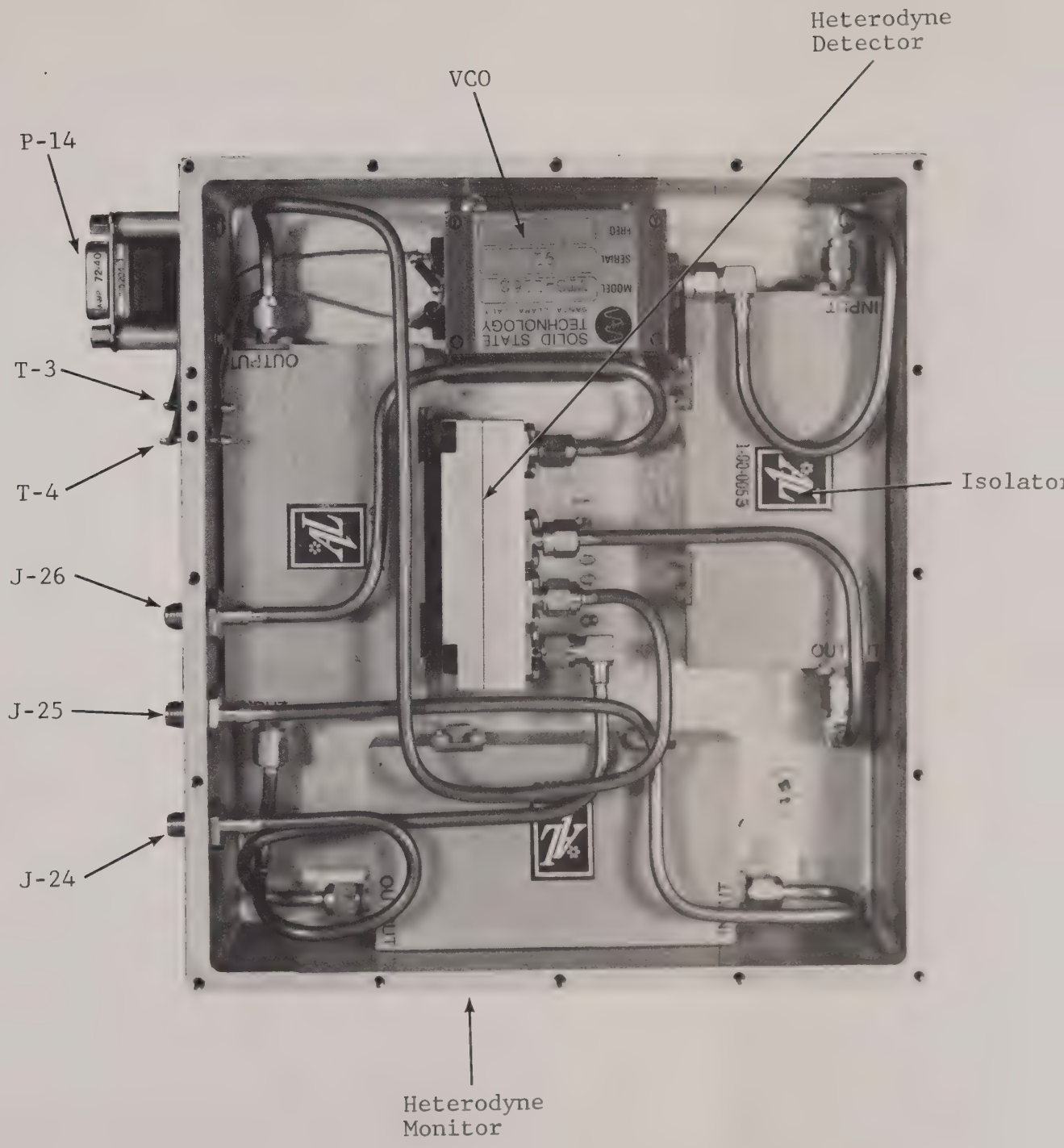


FIG. 9-5

RF FLOOR COMPONENTS
LOCATION


Heterodyne
Detector
VCO
P-14
T-3
T-4
J-26
J-25
J-24
Isolator
Heterodyne
Monitor

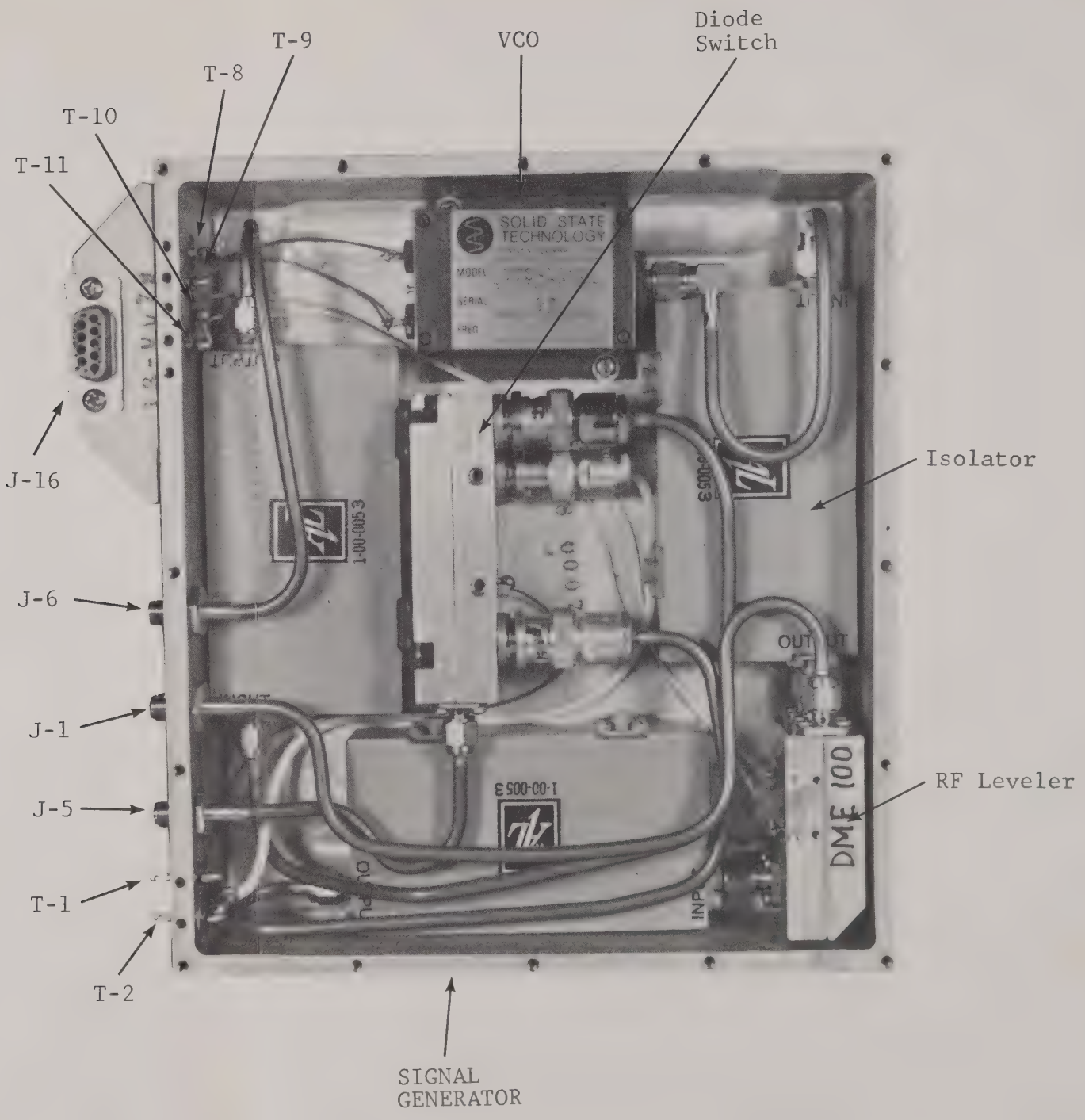
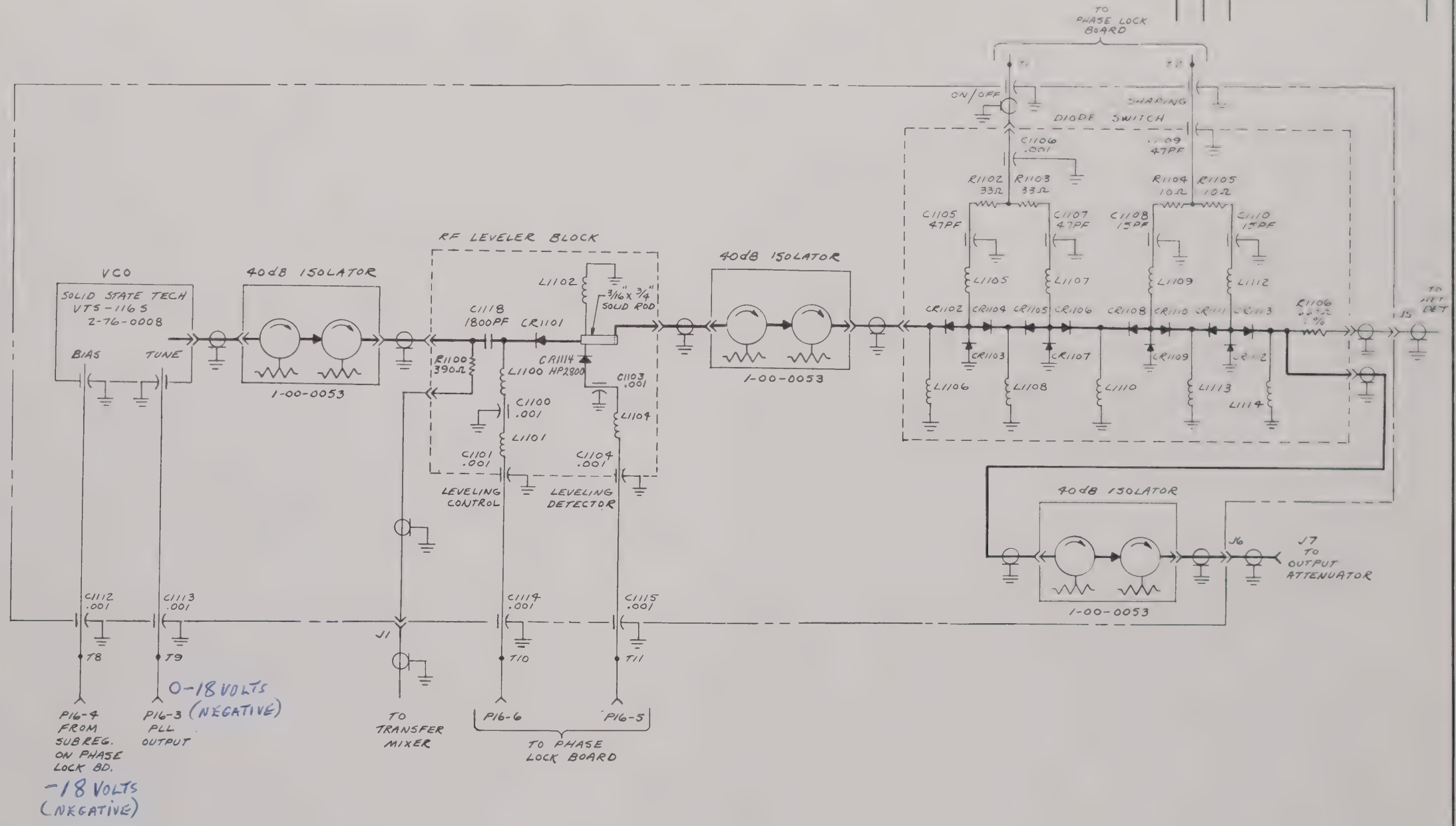


FIG.9-6

SIGNAL GENERATOR AND
HETERODYNE MONITOR

DATE	REV	CHANGE	APP'D
	A	INCORPORATED ECN #1 WP	



NOTES:
1. ALL R.F. CHOKES ARE .1μH UNLESS OTHERWISE SPECIFIED.
2. ALL DIODES ARE TYPE PSO-83B UNLESS OTHERWISE SPECIFIED.

NEXT ASS'Y	QT'Y	MODEL	ITEM REQ'D	PART NO.	DESCRIPTION
		DME-100			
APPLICATION			LIST OF MATERIALS		

TOLERANCES UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

MATERIAL
TREATMENT
FINISH

DRAWN JJG 7/27/73
CHECKED RJM 8/4/73
APPROVED RJM 8/6/73

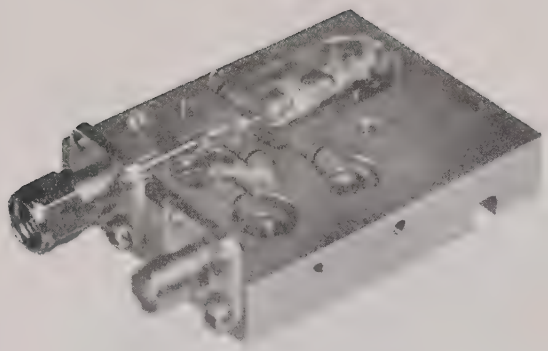
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: SIGNAL GENERATOR SCHEMATIC DME-100

SIZE C | PART NUMBER 3-18-0155 | REV —

SCALE | WEIGHT | SHEET OF

FIG. 9-7



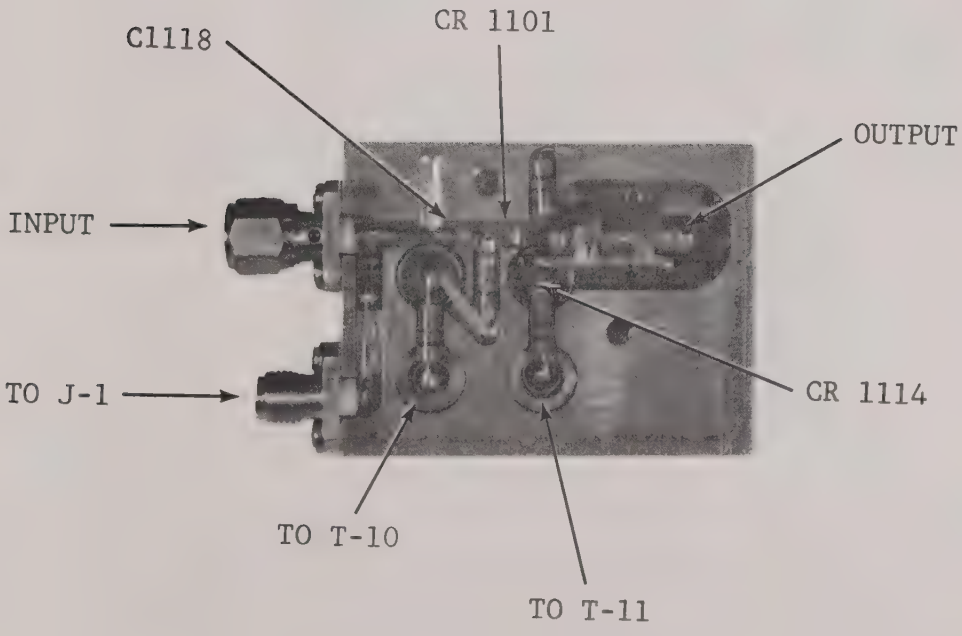
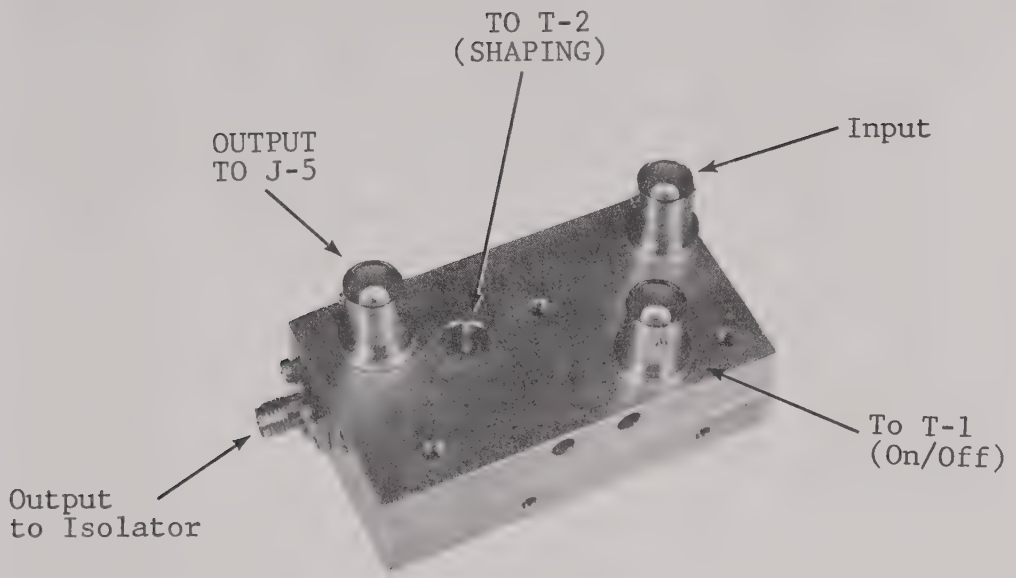


FIG. 9-8

RF LEVELER BLOCK



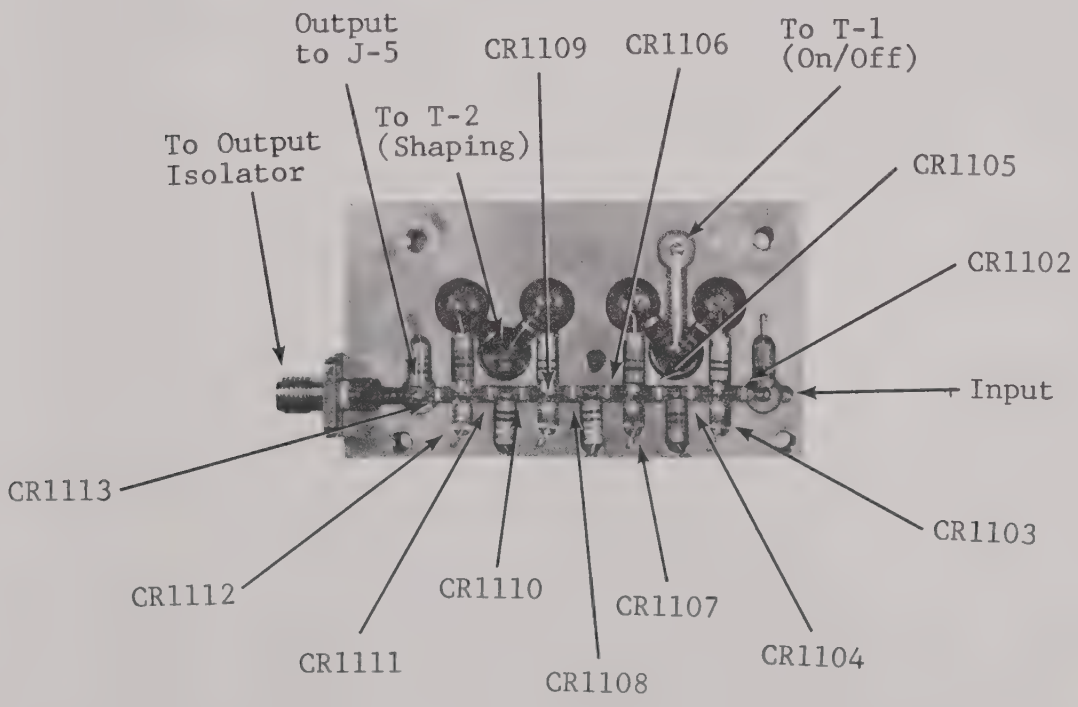
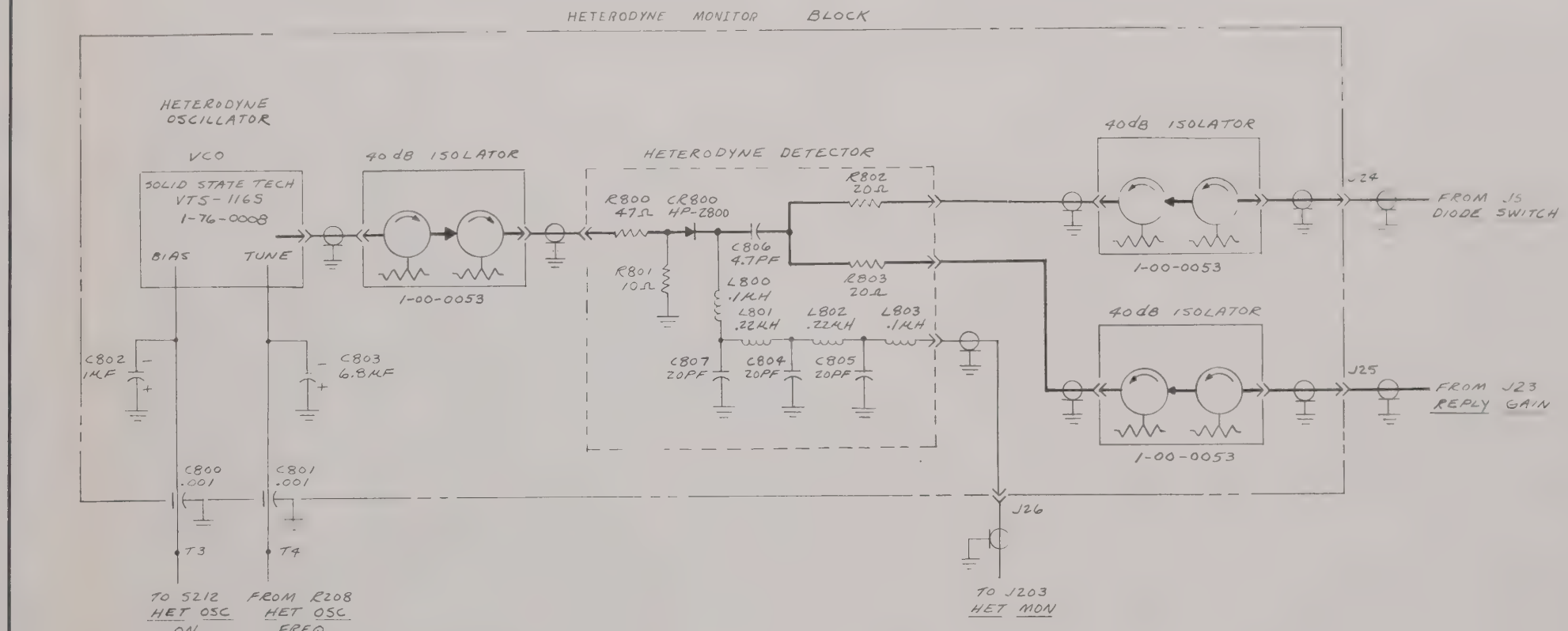
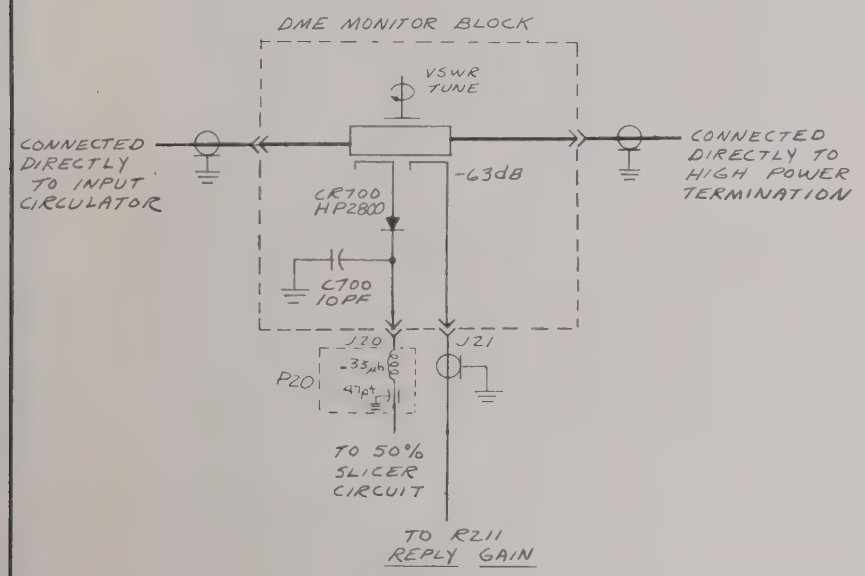


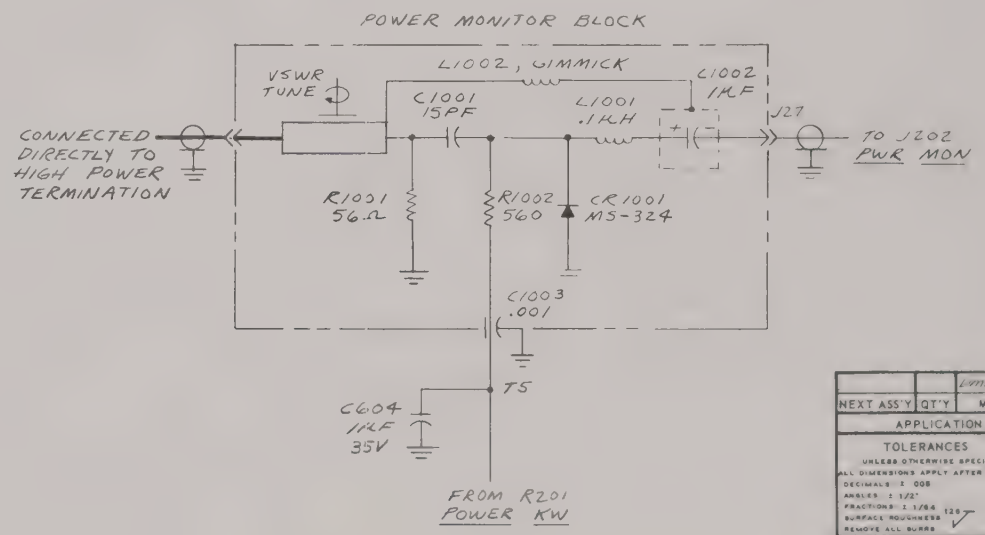
FIG. 9-9

DIODE SWITCH

DATE	REV	CHANGE	APP'D







NEXT ASS'Y	QT'Y	MODEL	ITEM REQ'D	PART NO	DESCRIPTION
APPLICATION			LIST OF MATERIALS		

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS ± .008
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN DATE
CHECKED DATE
APPROVED DATE

MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: MISC. RF BLOCK SCHEMATICS DME-100

SIZE C | PART NUMBER 3-18-0156 | REV

SCALE | WEIGHT | SHEET OF

FIG. 9-10

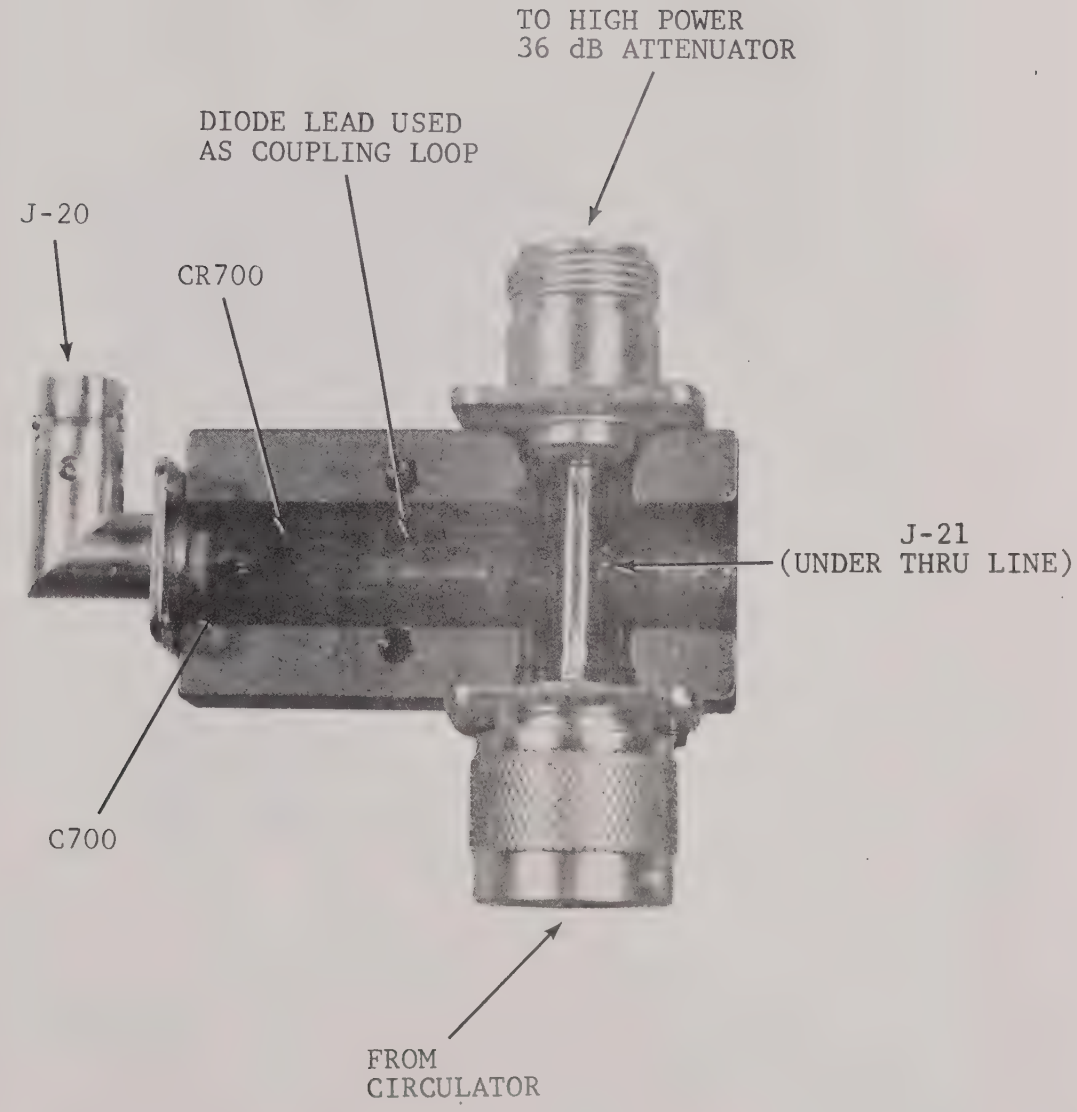


FIG. 9-12

DME MONITOR

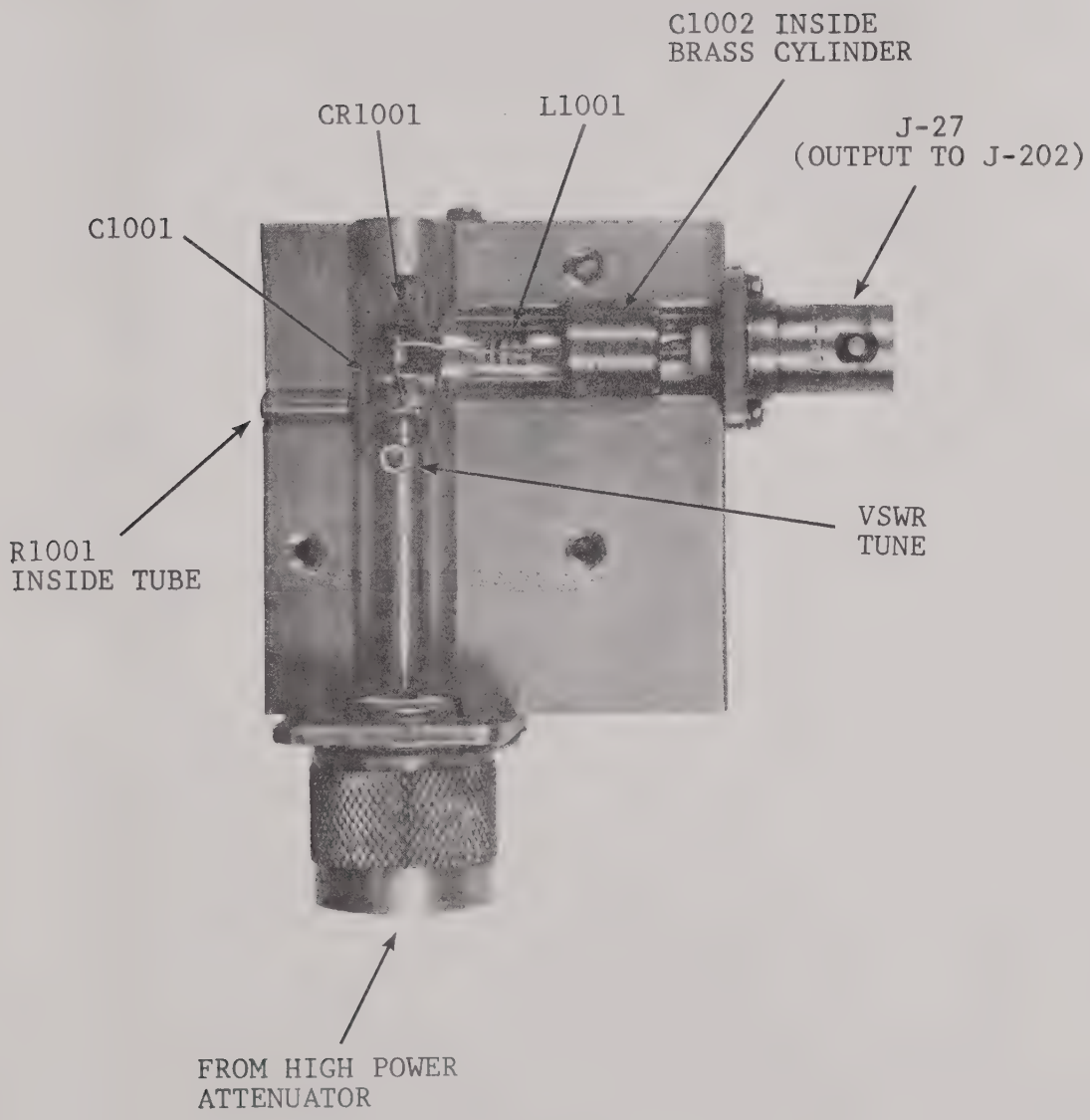


FIG. 9-13

POWER MONITOR

DATE	REV	CHANGE	APP'D

TRANSFER MIXER & PRESCALAR BLOCK

+20V

TB205

L901 15μH

C901 .001

100 MHZ LOCAL OSC. BD.

C902 .001

R901 100Ω

C903 .001

L902 2.2μh

R902 3.3K

C904 .001

Q901 2N3903

R903 390Ω

L903 1μh

R904 100Ω

L904 .1μh

Y901 100 MHz

C905 .001

C906 22pf

C907 68pf

C908 .7-9pf

L905

L906

TEST PORT

R905 22K

C909 47pf

R906 47K

CR901 PR161

900 MHz FILTER

900 MHz

L905: 4T #20 ON 1/4 DIA FORM.
L906: LOOP FORMED OVER L905.

FROM VCO

J2

R908 56Ω

R907 120Ω

PRESCALER DRIVER

+20V

Q902 2N5179

C921 .001

MIXER

Q901 2N5179

CR908 HP2800

R914 10K

R913 1.8K

R917 3.9K

R919 1.5K

A

C912 3.3pf

C913 .001

C914 100 pf

C917 10pf

C918 10 pf

C920 .01

R910 56Ω

R911 10K

R912 6.8K

R915 680Ω

R918 2.2K

C916 .001

C915 .001

R916 560Ω

-20V

÷100 PRESCALER BD. 1-00-0074D

÷2

÷2

÷5

MC1692L

MC1666L

MC1666L

X901B

X902B

X902A

X903B

X903A

X904 MC10Z7L

X905 MC10Z7L

X906 MC10Z7L

+5V

+5

R924 560Ω

R928 560Ω

C922 .0018

R921 270Ω

X901A

R922 560Ω

R923 560Ω

R925 560Ω

R926 2.2K

R927 2.2K

R929 2.2K

Q904 2N3905

Q905 2N3905

R930 27Ω

R932 390Ω

R933 1.1K

R931 82Ω

C923 .018

X907 SN7490

÷5

Q906 2N3646

R934 220Ω

R935 100Ω

J3

TO COUNTER SWITCH

"1KHZ VARIABLE"

J4

TO PHASE LOCK CKTS.

T5 C924 .001 -20V

T6 C925 .001 +5V

T7 C926 .001 +20V

NEXT ASS'Y	QT'Y	MODEL	ITEM REQ'D	PART NO.	DESCRIPTION
		DME-100			

APPLICATION

LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH

DRAWN JJG 7/21/73
CHECKED R.J.M. 8/1/73
APPROVED R.J.M. 8/1/73

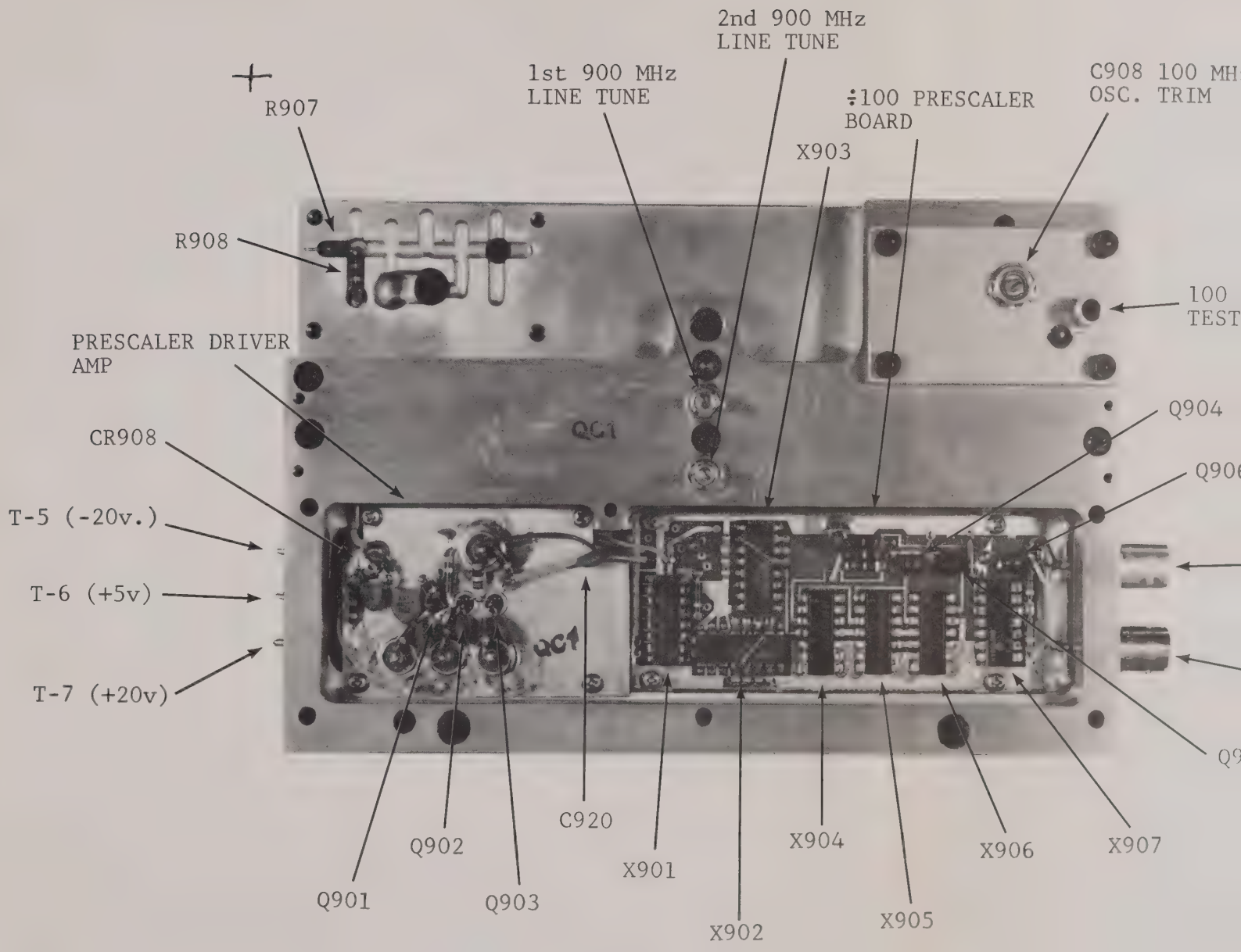
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: TRANSFER MIXER & PRESCALAR BLOCK SCHEMATIC

SIZE C | PART NUMBER 3-18-0152 | REV

SCALE | WEIGHT | SHEET OF

FIG. 9-14


2nd 900 MHz
LINE TUNE
1st 900 MHz
LINE TUNE
÷100 PRESCALER
BOARD
C908 100 MH
OSC. TRIM
R907
X903
R908
100
TEST
PRESCALER DRIVER
AMP
Q904
CR908
Q906
T-5 (-20v.)
T-6 (+5v)
T-7 (+20v)
C920
Q902
X904
X906
X907
X901
Q901
Q903
X902
X905

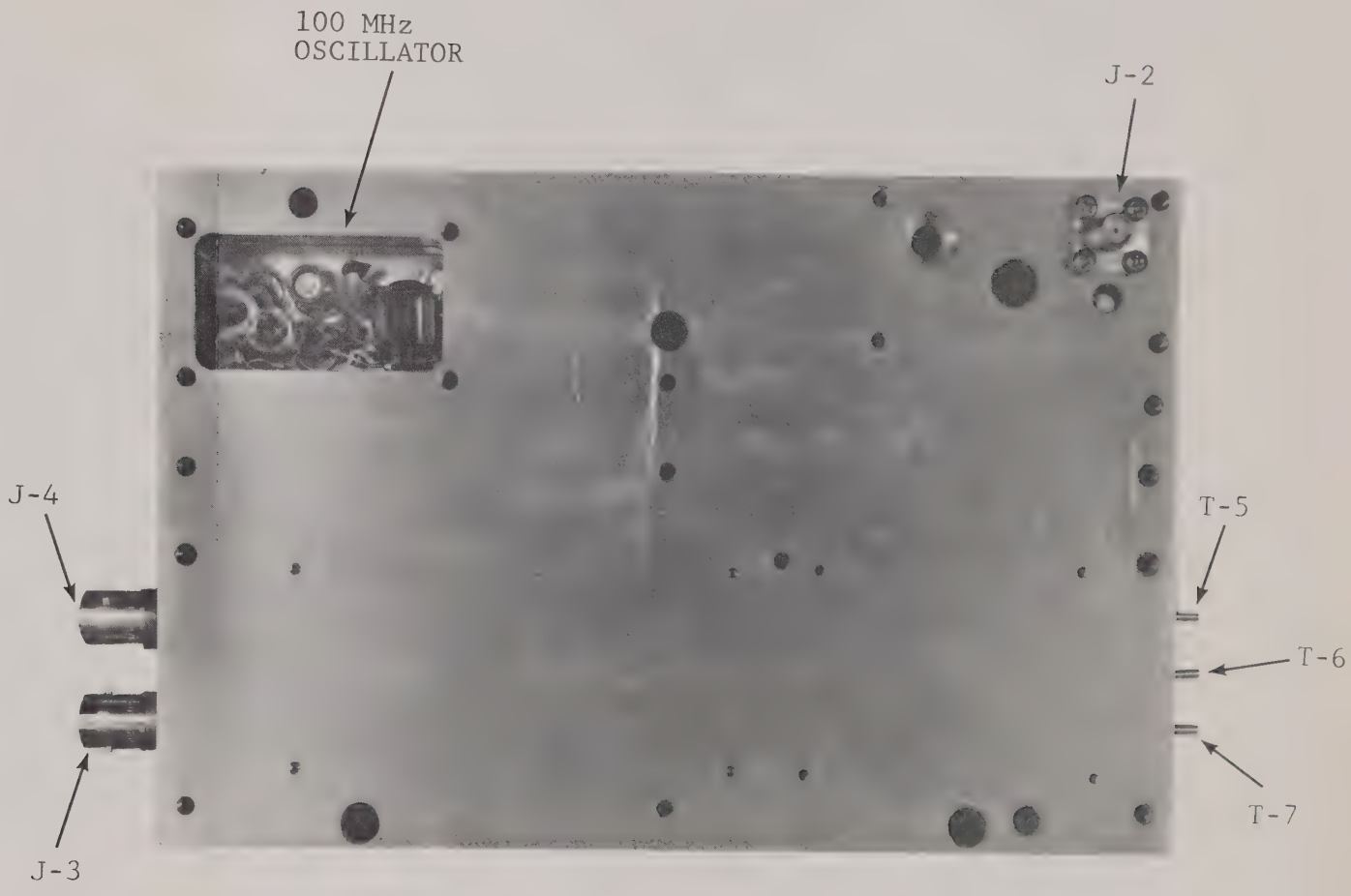
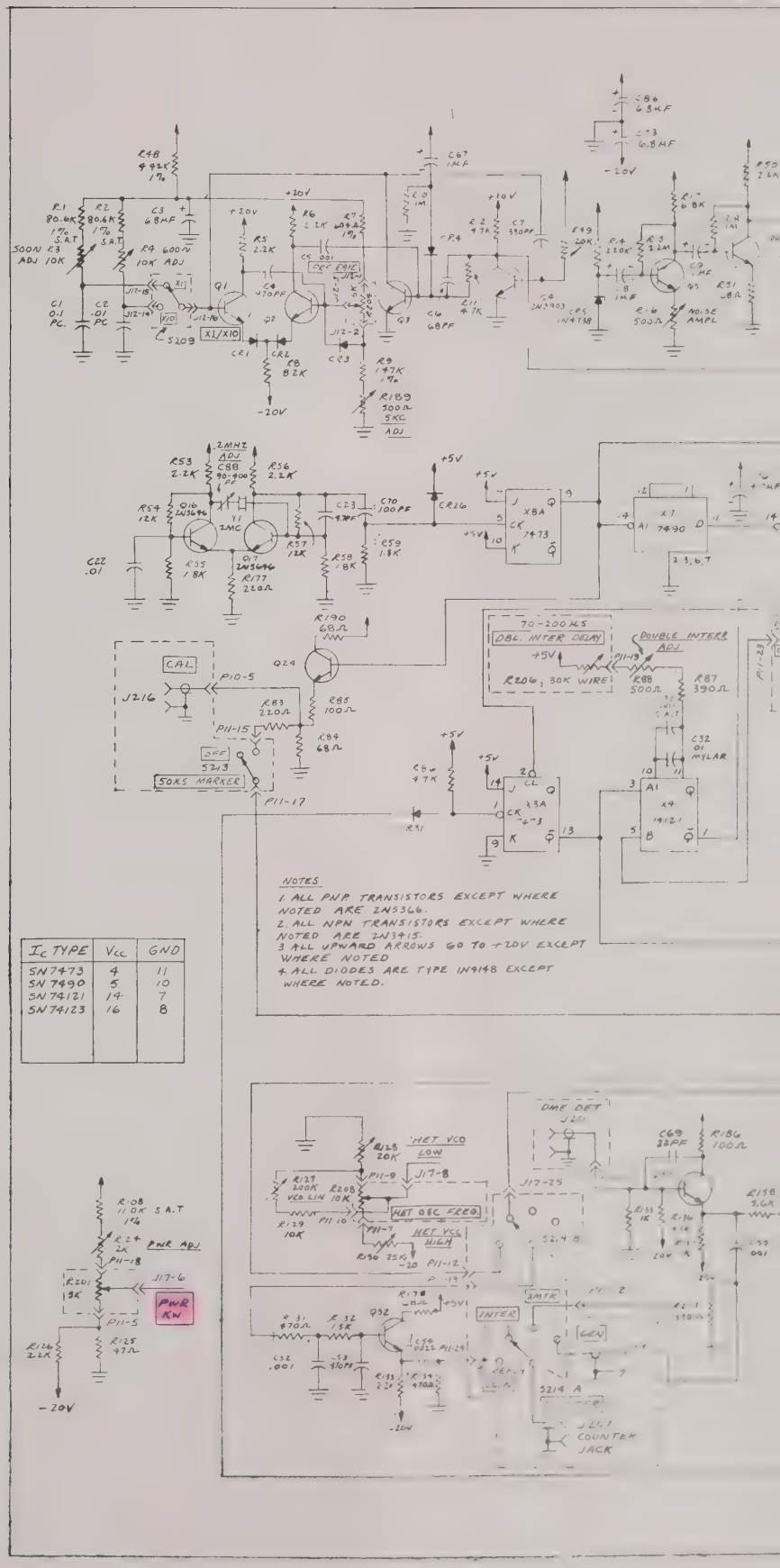
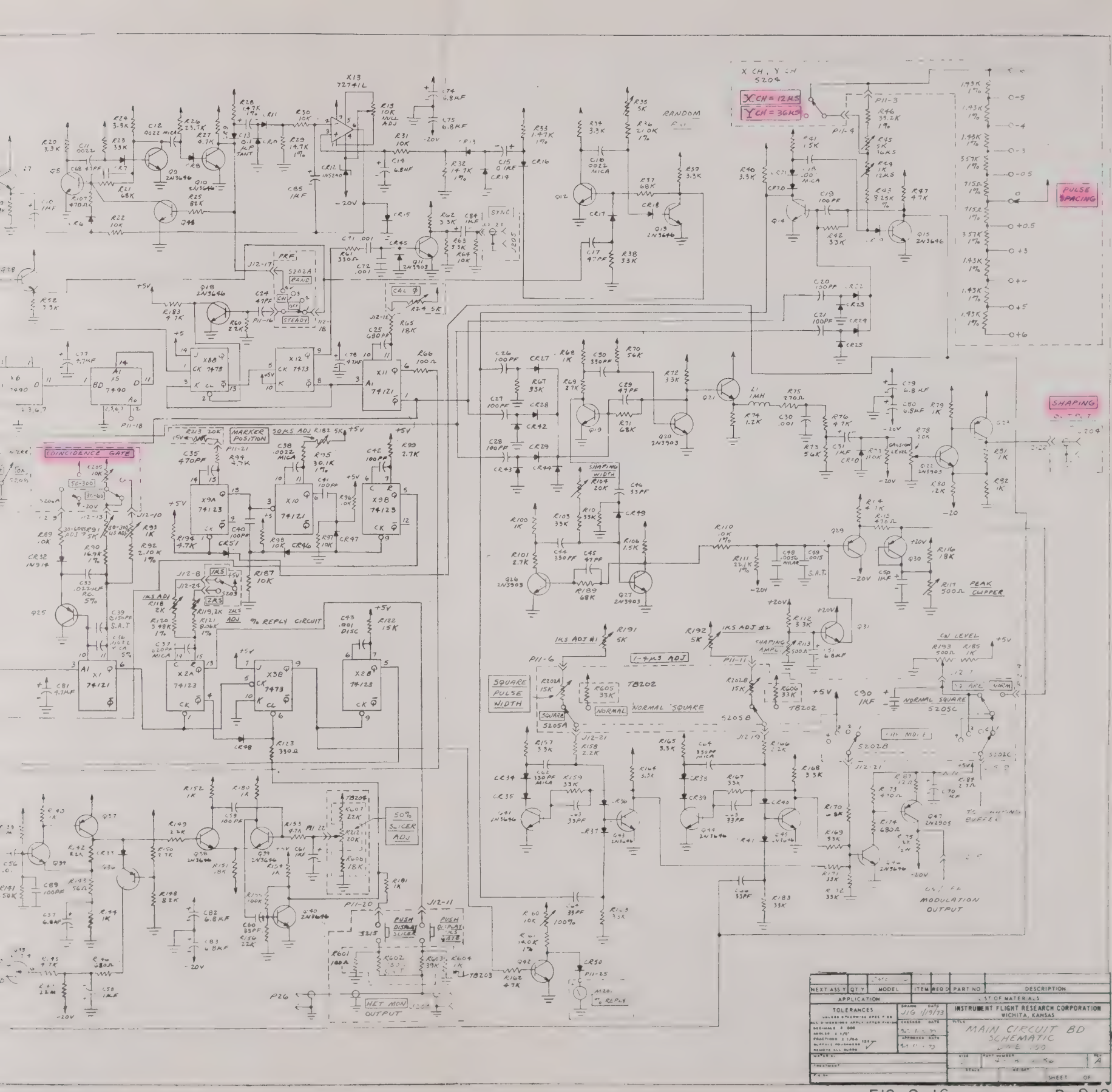


FIG. 9-15

TRANSFER OSCILLATOR
AND PRESCALER



I_C TYPE	V_{CC}	GND
SN7473	4	11
SN7490	5	10
SN74121	14	7
SN74123	16	8



NEXT ASS'Y	QTY	MODEL	ITEM REQ'D	PART NO	DESCRIPTION
APPLICATION				LIST OF MATERIALS	

TOLERANCES — UNLESS OTHERWISE SPEC'D ±10
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS ± .005
ANGLES ± 1/2°
FRACTIONS 1/64
REMOVE ALL BURRS

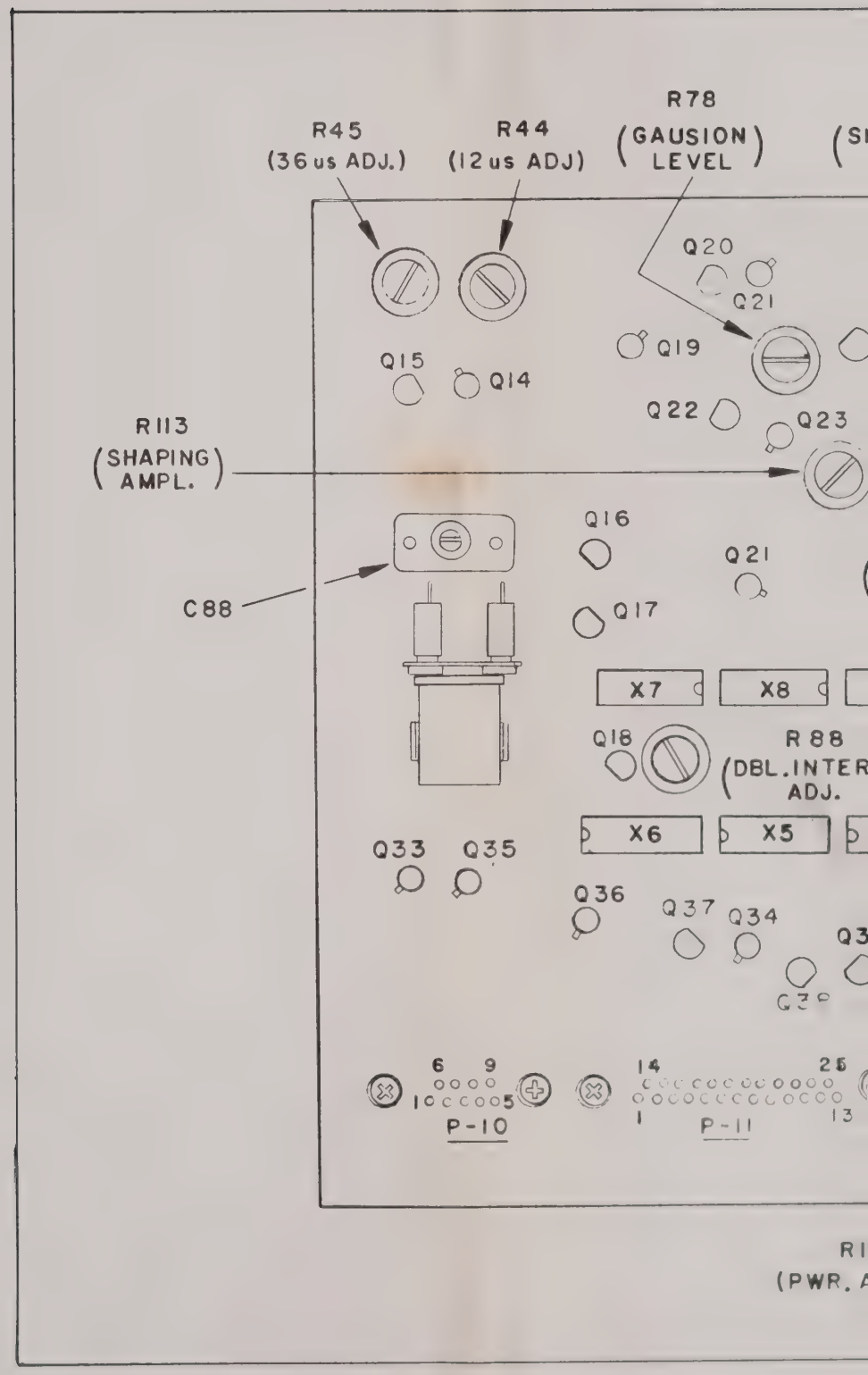
DRAWN JIG 1/19/73 — CHECKED — APPROVED 4-11-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: MAIN CIRCUIT BD SCHEMATIC
LINE 150

SIZE — PART NUMBER — REV A
SCALE — WEIGHT — SHEET OF

FIG. 9-16


R45
(36 us ADJ.)
R44
(12 us ADJ)
R78
(GAUSION
LEVEL)
Q20
Q21
Q19
Q15
Q14
Q22
Q23
R113
(SHAPING
AMPL.)
Q16
Q21
C88
Q17
X7
X8
Q18
R88
(DBL. INTER
ADJ.
X6
X5
Q33
Q35
Q36
Q37
Q34
6
9
10
5
P-10
14
25
1
13
P-11

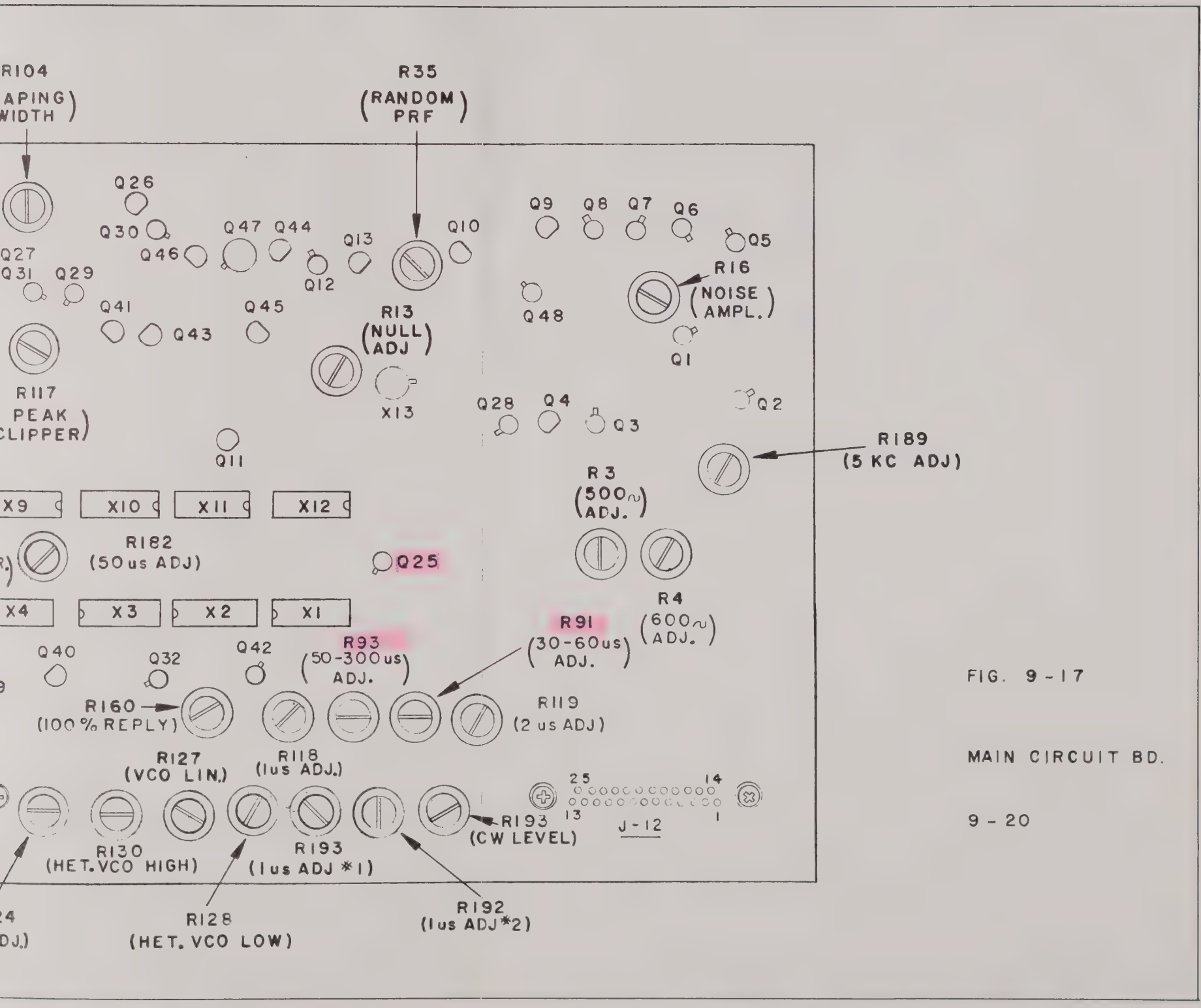


FIG. 9-17

MAIN CIRCUIT BD.

DATE	REV	CHANGE	APPD
	A	[illegible]	

NOTES:

1. ALL PNP TRANSISTORS EXCEPT WHERE NOTED ARE 2N5366.
2. ALL NPN TRANSISTORS EXCEPT WHERE NOTED ARE 2N3415.
3. ALL UPWARD ARROWS GO TO +20V EXCEPT WHERE NOTED.
4. ALL DIODES ARE TYPE IN4148 EXCEPT WHERE NOTED.

NEXT ASS'Y	QT'Y	MODEL	ITEM REQ'D	PART NO.	DESCRIPTION
		OME 100			

APPLICATION — LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS APPLY AFTER FINISH; DECIMALS ± .000; ANGLES: ± 1/2°; FRACTIONS: ± 1/64; SURFACE ROUGHNESS 125 √; REMOVE ALL BURRS

DRAWN JG 11/26/73 — CHECKED RDM 12/4/73 — APPROVED RDM 12/5/73

MATERIAL — TREATMENT — FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: PHASE-LOCK BD. SCHEMATIC OME-100

SIZE C — PART NUMBER 3-18-0087 — REV A

SCALE — WEIGHT — SHEET OF

FIG. 9-18

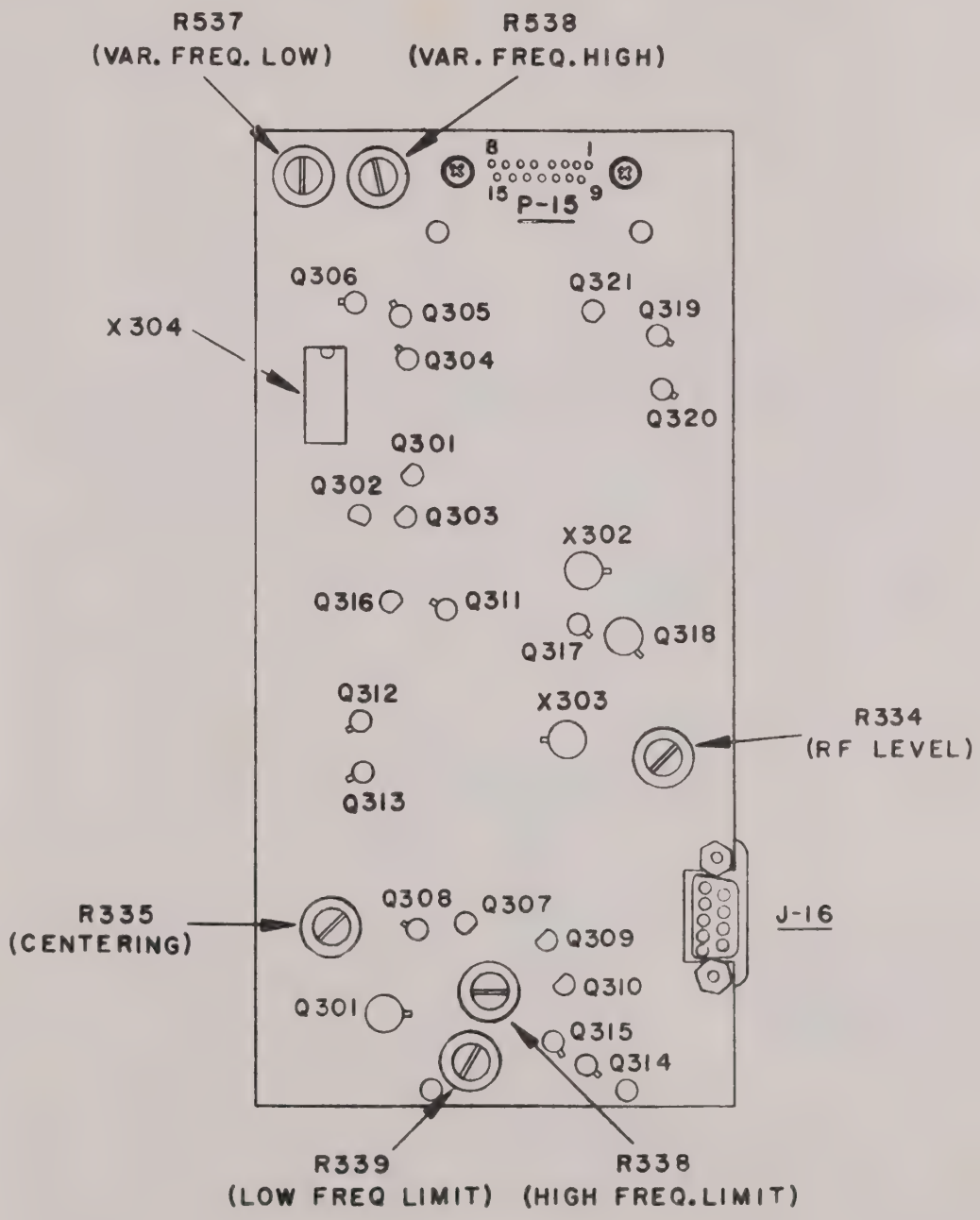
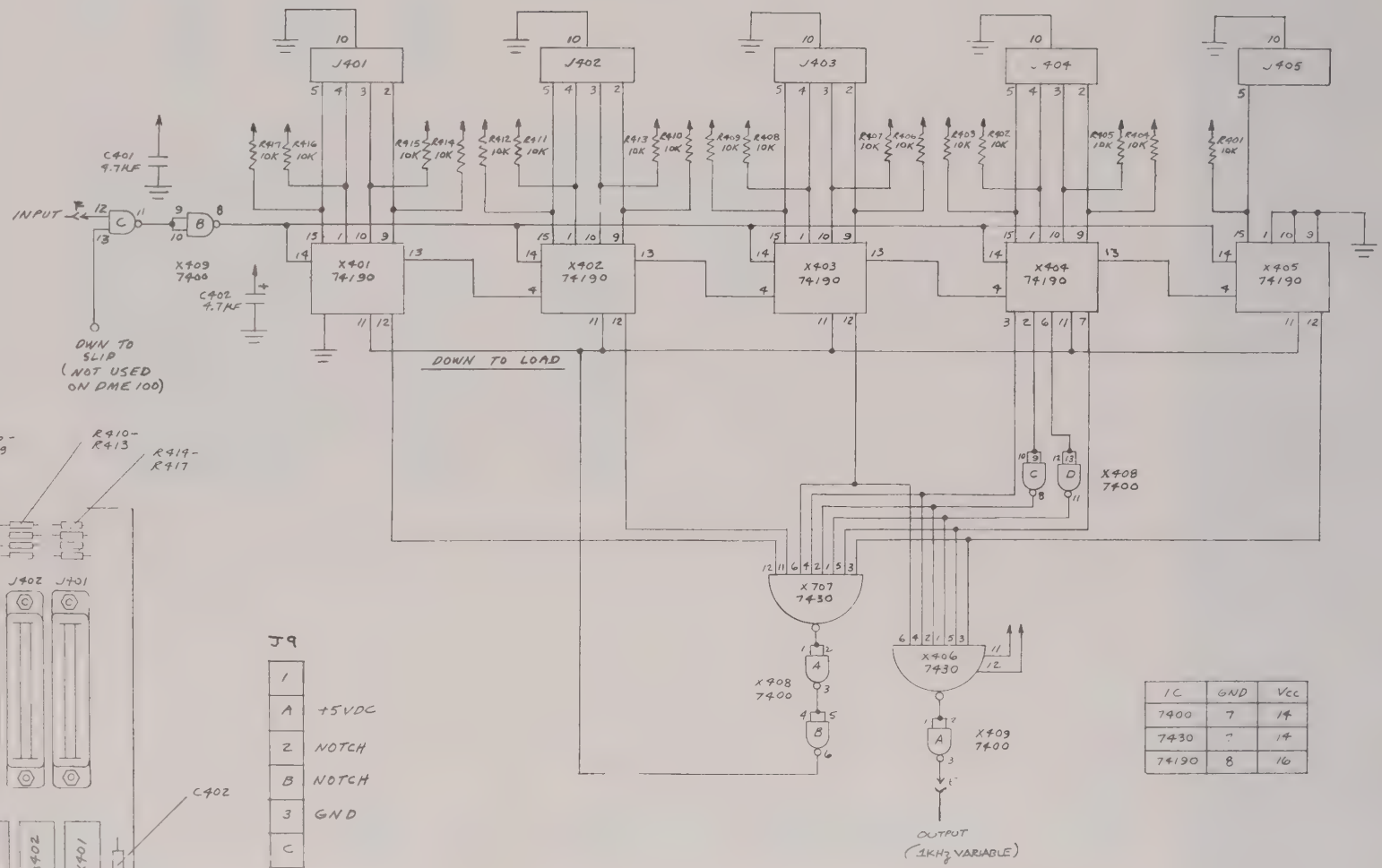
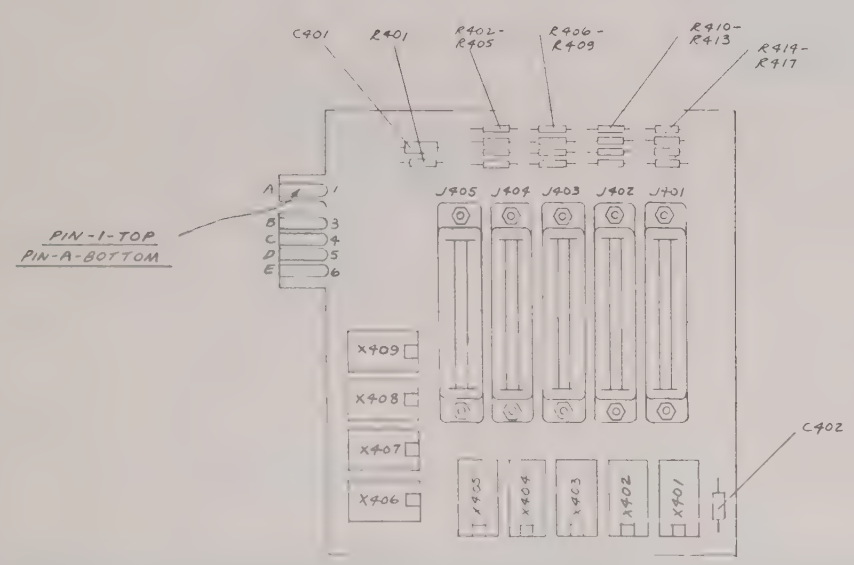


FIG. 9-19

PHASE LOCK
BOARD

DATE	REV	CHANGE	APP'D





J9	
1	
A	+5VDC
2	NOTCH
B	NOTCH
3	GND
C	
4	
D	SLIP
5	
E	OUTPUT
6	
F	INPUT

IC	GND	Vcc
7400	7	14
7430	7	14
74190	8	16

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
		DME 100				

APPLICATION — LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .008
ANGLES: ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN JIG 11/6/73 | CHECKED 1-10-74 | APPROVED

MATERIAL | TREATMENT | FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: PROGRAM DIVIDER SCHEMATIC DME 100

SIZE | PART NUMBER 3-018 0088 | REV

SCALE | WEIGHT | SHEET OF

FIG. 9-20

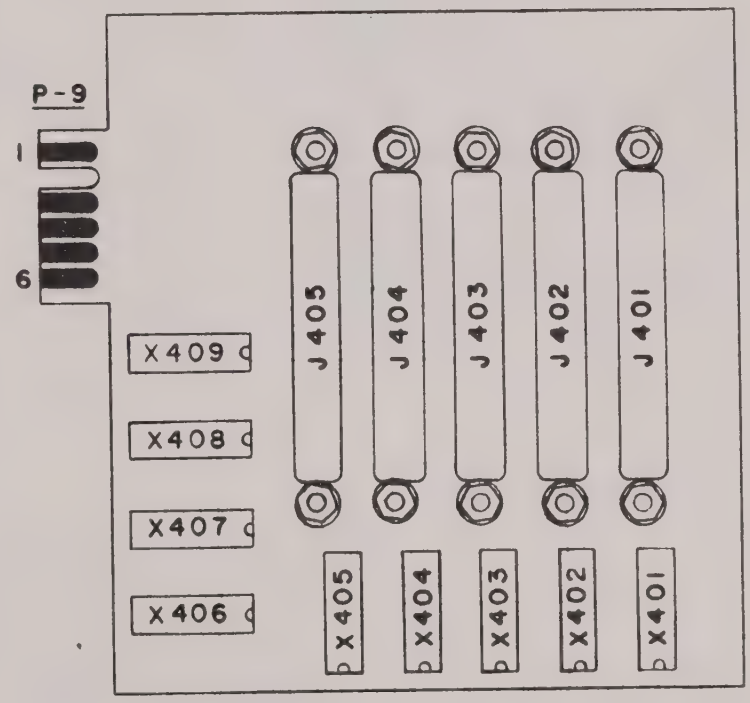
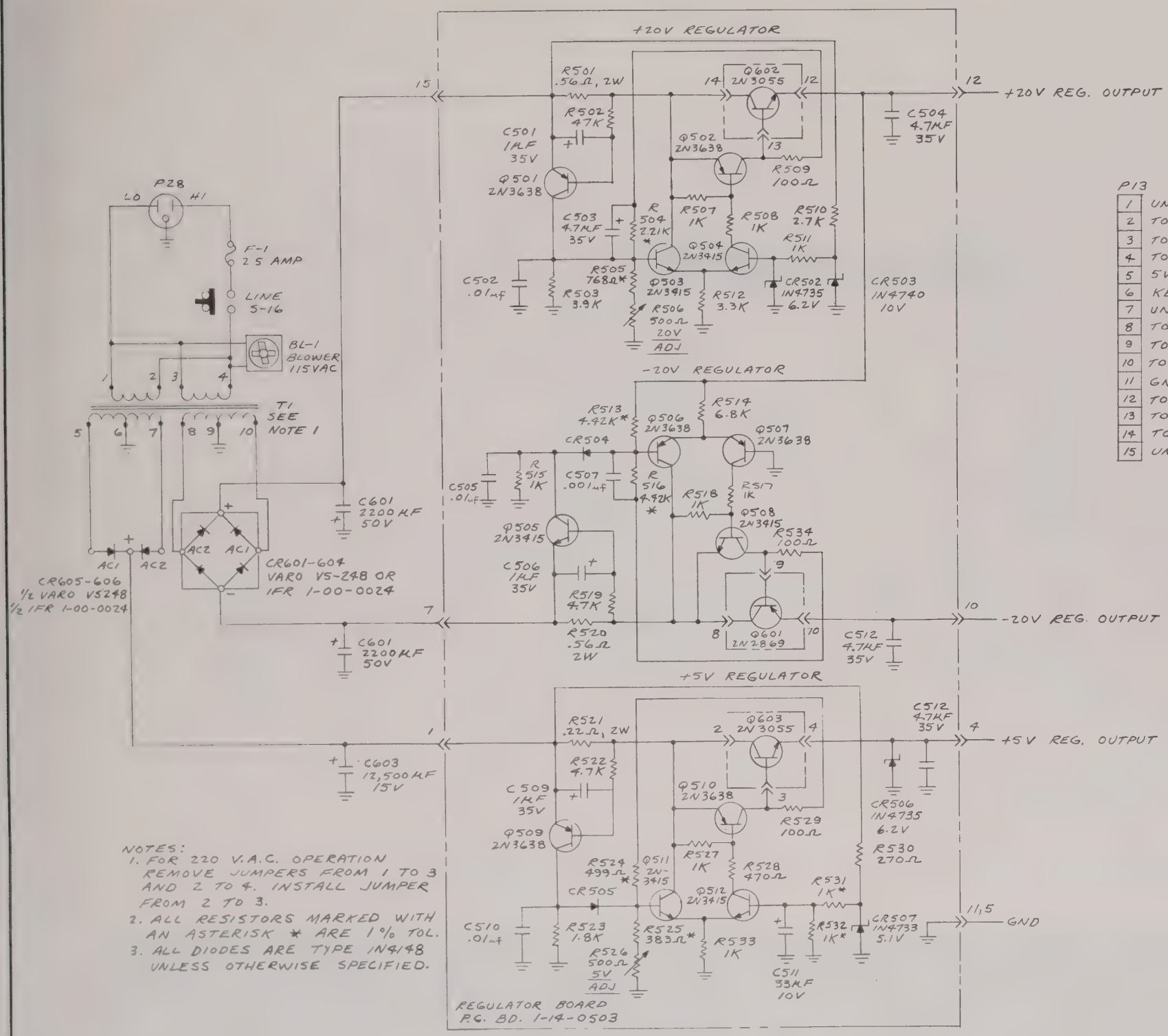


FIG. 9-21

PROGRAMMED
DIVIDER BOARD

DATE	REV	CHANGE	APP'D



P13	
1	UNREGULATED 5V INPUT
2	TO COLLECTOR OF Q3.
3	TO BASE OF Q3.
4	TO EMITTER OF Q3, +5V OUTPUT.
5	5V GND.
6	KEY
7	UNREGULATED -20V INPUT.
8	TO COLLECTOR OF Q2.
9	TO BASE OF Q2.
10	TO EMITTER OF Q2, -20V OUTPUT.
11	GND.
12	TO EMITTER OF Q1, +20V OUTPUT
13	TO BASE OF Q1.
14	TO COLLECTOR OF Q1.
15	UNREGULATED +20V INPUT.

NOTES:
1. FOR 220 V.A.C. OPERATION REMOVE JUMPERS FROM 1 TO 3 AND 2 TO 4. INSTALL JUMPER FROM 2 TO 3.
2. ALL RESISTORS MARKED WITH AN ASTERISK * ARE 1% TOL.
3. ALL DIODES ARE TYPE IN4148 UNLESS OTHERWISE SPECIFIED.

NEXT ASS'Y	QT'Y	MODEL	ITEM REQ'D	PART NO	DESCRIPTION
		DME-100			

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH

DRAWN JLS 7/30/73
CHECKED RJM 8/4/73
APPROVED RJM 8/4/73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: DME-100 POWER SUPPLY SCHEMATIC

SIZE C | FAB NUMBER 3-18-0157 | REV —

SCALE | WEIGHT | SHEET OF

FIG. 9-22

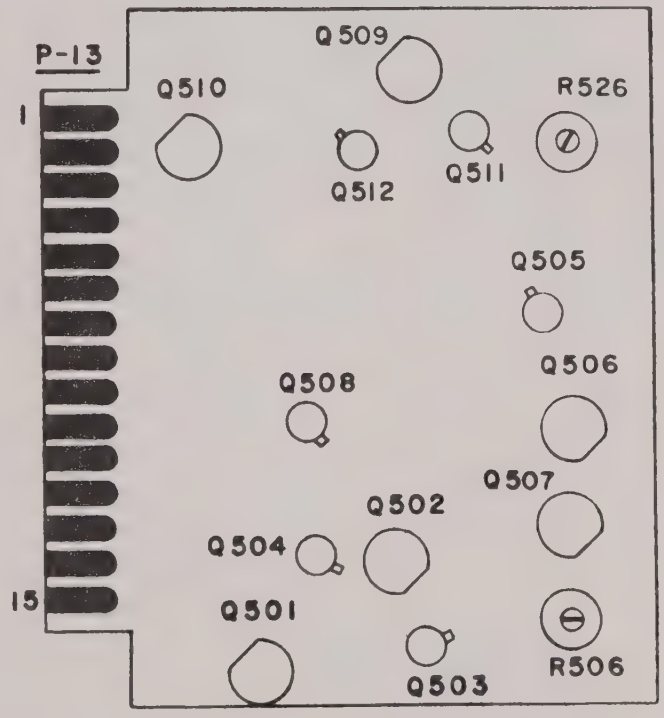


FIG. 9-23

POWER SUPPLY
REGULATOR

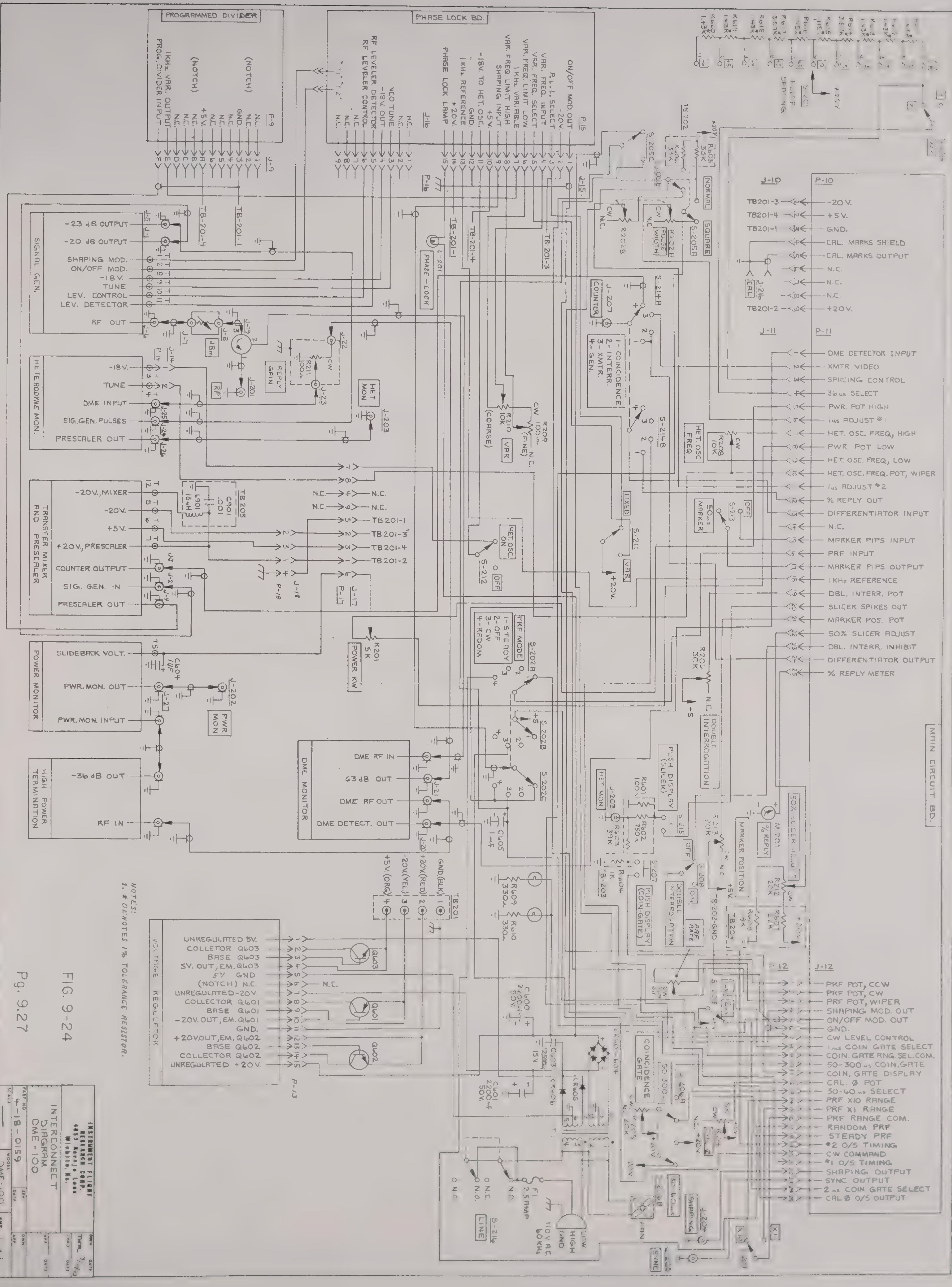

PROGRAMMED DIVIDER
P-9
J-9
N.C.
GND.
(NOTCH)
+5V.
1KHz VAR. OUTPUT
PROG. DIVIDER INPUT
PHASE LOCK BD.
P-15
ON/OFF MOD. OUT
-20V.
P.L.L. SELECT
VAR. FREQ. INPUT
VAR. FREQ. SELECT
VAR. FREQ. LIMIT LOW
1 KHz VARIABLE
VAR. FREQ. LIMIT HIGH
SHAPING INPUT
+5V.
-18V. TO HET. OSC.
GND.
1 KHz REFERENCE
+20V.
PHASE LOCK LAMP
J-16
P-16
J-15
VCO TUNE
-18V. OUT
RF LEVELER DETECTOR
RF LEVELER CONTROL
"T1" "T2"
SIGNAL GEN.
-23 dB OUTPUT
-20 dB OUTPUT
SHAPING MOD.
ON/OFF MOD.
-18 V.
TUNE
LEV. CONTROL
LEV. DETECTOR
RF OUT
J-5
J-1
J-6
J-7
J-8
J-19
dBm
RF
J-201
J-22
J-23
R211 100Ω
REPLY GAIN
CW
HET MON
J-203
TB-201-4
TB-201-1
TB-201-3
L-201
PHASE-LOCK
HETERODYNE MON.
-18V.
TUNE
DME INPUT
SIG. GEN. PULSES
PRESCALER OUT
P-14
J-14
J-25
J-24
J-26
TRANSFER MIXER AND PRESCALER
-20V., MIXER
-20V.
+5V.
+20V., PRESCALER
COUNTER OUTPUT
SIG. GEN. IN
PRESCALER OUT
J-3
J-2
J-4
TB 205
C901 .001
L901 15uH
N.C.
TB201-1
TB201-3
TB201-4
TB201-2
P-18
J-18
J-17
P-17
R201 5K
POWER KW
POWER MONITOR
SLIDEBACK VOLT.
PWR. MON. OUT
PWR. MON. INPUT
C604 1uF
J-27
J-202
PWR MON
HIGH POWER TERMINATION
-36 dB OUT
RF IN
DME MONITOR
DME RF IN
63 dB OUT
DME RF OUT
DME DETECT. OUT
J-21
J-20
+5V.(ORG)
-20V.(YEL)
+20V.(RED)
GND.(BLK)
TB201
VOLTAGE REGULATOR
UNREGULATED 5V.
COLLETOR Q603
BASE Q603
5V. OUT, EM. Q603
5V GND
(NOTCH) N.C.
UNREGULATED-20V.
COLLECTOR Q601
BASE Q601
-20V. OUT, EM. Q601
GND.
+20V.OUT, EM. Q602
BASE Q602
COLLECTOR Q602
UNREGULATED +20V.
P-13
Q603
Q601
Q602
NOTES:
1. * DENOTES 1% TOLERANCE RESISTOR.
S 205C
S-205A
S-205B
TB 202
R605 33K
R606 33K
NORMAL
SQUARE
R202A PULSE WIDTH
R202B
CW
N.C.
+20V
S-201
PULSE SPACING
R620 1.43K
R619 1.43K
R618 1.43K
R617 357K
R616
R615
R614
J-207
COUNTER
S-214A
S-214B
1- COINCIDENCE
2- INTERR.
3- XMTR.
4- GEN.
R210 10K
(COARSE)
R209 100Ω
(FINE)
VAR
HET. OSC FREQ
R208 10K
HET. OSC. ON
S-212
OFF
FIXED
S-211
VAR.
+20V.
50us MARKER
S-213
PRF MODE
S-202A
1- STEADY
2- OFF
3- CW
4- RADOM
S-202B
S-202C
C605 1uf
R206 30K
N.C.
+5
DOUBLE INTERROGATION
PUSH DISPLAY (SLICER)
HET MON
J-203
R601 100Ω
R602 750Ω
R603 39K
R604 1K
TB-203
S-215
S-207
PUSH DISPLAY (COIN. GATE)
DOUBLE INTERROGATION
S-208
ON
R213 20K
MARKER POSITION
M 201
% REPLY
50% SLICER ADJUST
R212 20K
R607
R608 3K
TB-202-GND
TB204
PRF RATE
R609 330Ω
R610 330Ω
C600 2200uf 50V.
C603 12,500uf 15V
C601 2200uf 50V.
CR605
CR606
CR601-604
T1
COINCIDENCE GATE
50 300us
R205 20K
+20V
CAL Ø
S-216
LINE
O.N.C.
N.O.
F1 2.5AMP
110V A.C. 60KHz
LOW
HIGH
GND
FAN
SHAPING
J-204
SYNC
30 60us
MAIN CIRCUIT BD.
J-10
P-10
TB201-3
TB201-4
TB201-1
TB201-2
-20 V.
+5 V.
GND.
CAL. MARKS SHIELD
CAL. MARKS OUTPUT
N.C.
+20V.
J-216
CAL
J-11
P-11
DME DETECTOR INPUT
XMTR VIDEO
SPACING CONTROL
36us SELECT
PWR. POT HIGH
1us ADJUST *1
HET. OSC. FREQ, HIGH
PWR. POT LOW
HET. OSC. FREQ, LOW
HET. OSC. FREQ. POT, WIPER
1us ADJUST *2
% REPLY OUT
DIFFERENTIATOR INPUT
N.C.
MARKER PIPS INPUT
PRF INPUT
MARKER PIPS OUTPUT
1 KHz REFERENCE
DBL. INTERR. POT
SLICER SPIKES OUT
MARKER POS. POT
50% SLICER ADJUST
DBL. INTERR. INHIBIT
DIFFERENTIATOR OUTPUT
% REPLY METER
P-12
J-12
PRF POT, CCW
PRF POT, CW
PRF POT, WIPER
SHAPING MOD. OUT
ON/OFF MOD. OUT
GND.
CW LEVEL CONTROL
1us COIN GATE SELECT
COIN. GATE RNG. SEL. COM.
50-300us COIN. GATE
COIN. GATE DISPLAY
CAL. Ø POT
30-60us SELECT
PRF X10 RANGE
PRF X1 RANGE
PRF RANGE COM.
RANDOM PRF
STEADY PRF
*2 O/S TIMING
CW COMMAND
*1 O/S TIMING
SHAPING OUTPUT
SYNC OUTPUT
2us COIN GATE SELECT
CAL Ø O/S OUTPUT
INSTRUMENT FLIGHT RESEARCH CORP.
4853 Navajo Lane
Wichita, Ks.
INTERCONNECT DIAGRAM DME-100
PART NO 4-18-0159
MODEL DME-100
SHT. 1 of 1
DWN TWM 7/-/73

FIG. 9-24

Pg. 9.27

SECTION X

Condensed Parts List

10-1. Signal Generator.

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
-	Signal Generator System	L-Band Osc and Mod	1-18-0014	9	1
-	VCO, VTS-7113	Voltage Controlled Osc	2-76-0008	19	1
-	40dB Isolator		1-00-0053	1	2
-	RF Leveler Mod		1-18-0065	9	1
CR1101	PSO-83B Pin Diode	Diode Atten	PSO-83B	16	1
CR1100	HP-2800	RF Detector	HP-2800	8	1
C1118	1800pf Chip Cap	Coupling			1
-	Diode Sw Mod		1-18-0064	9	1
CR1102	PSO-83B Pin	Pin Diode Modulator	PSO-83B	16	12
CR1113	Diode				

10-2. Miscellaneous RF Components.

	Output Atten	-25 to -135dB Att	1-18-0071	9	1
	Circulator		1-00-0054	1	1

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
	DME Monitor Mod	Reply Det, RF Coupler	1-18-0029	9	1
CR700	HP-2800 Diode	RF Det	HP-2800	8	1
	Power Monitor Mod	Peak Pwr Meas	1-18-0016	9	1
CR1001	MS-324 Diode	RF Det	MS-324	20	1
	36dB Pad	36dB Atten 30W	1-76-0049	12	1

10-3. Transfer Mixer and Prescaler.

	Transfer Mixer & Prescaler Mod	Subtracts 900 MHz from VCO freq and ÷ by 100	1-18-0021	9	1
	100 MHz Local Osc Bd	Osc/Driver for snap diode	1-14-0217	9	1
CR901	RR161 Diode	Snap diode for X9 freq multiplication	PR-161	16	1
	Prescaler Driver Board	Amplifier for Transfer mixer output	1-14-0544	9	1
CR908	HP-2800 Diode	Mixer	HP-2800	8	1
Q901-903	2N5179	RF Amp	2N5179	17	3

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
	Prescaler Bd	÷ 100 Prescaler	1-00-0074D	9	1
X901	MC1692L	Dual ECL Line Rec'r	MC1692L	13	1
X902/ 903	MC1666L	Dual ECL S-R Flip-Flop	MC1666L	13	2
X904/ 906	MC1027L	ECL J-K Flip Flop	MC1027L	13	3
X907	SN7490	Divide-by-five counter	SN7490	21	1
Q904/ 905	2N3905	Logic Lev translator	2N3905	14	2
Q906	2N3646	Buffer	2N3646	14	1

10-4 Heterodyne Monitor Module.

	Heterodyne Mon System	Accomplish display of Interr and Replies	1-18-0035	9	1
	Isolator	40dB RF Isolator	1-00-0053	1	3
	Heterodyne Det Mod	2 input mixer and filter	3-18-0015	9	1
CR800	HP-2800	Mixer Diode	HP-2800	8	1

10-5. Main Circuit Board.

Ref Desg	Name of Part & Description	Circuit Function	IRF Part Number	Mfg Code	Total Ident Parts
	Main Cir Bd	Pulse Gen & Processing	1-18-0111	9	1
Q1-10, 12-14, 19, 21, 24, 28, 31-34, 42,48	2N3415, NPN	Various Tasks	2N3415	19	23
Q11,20, 22, 26, 27	2N3903, NPN	Various Tasks	2N3903	14	5
Q15-18, 38-41, 43-46	2N3646, NPN	Various Tasks	2N3646	14	12
Q23,25 29,30, 36,37	2N5366, PNP	Various Tasks	2N5366	19	6
Q35	UC714, P-Channel RET	AGC Amp Feedback	UC714	14	1
Q47	2N2905, PNP	Buffer	2N2905	14	1
CR1-4, 6-11,13-31, 33-44, 46, 47, 49-51	1N4148, Sig Diode	Various Tasks	1N4148	19	47
CR32	1N914/1N4148	Switch	1N914/ 1N4148	19	1

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
CR5	1N4738, 8.2V Zener Diode	Noise Source	1N4738	7	1
CR12	1N5240/1N4740 10V Zener Diode	-10V Supply	1N5240/ 1N4740	7	1
X13	SN72741L, Op Amp	Differential Integrator	SN72741L	21	1
X3,8, 12	SN7473N, Dual J-K Flip-Flop	Various Tasks	SN7473N	21	3
X5,6,7	SN7490N, Decode Counter	Divide by 1000	SN7490N	21	3
X1,4, 10,11	SN74121N, One-shot Multivibrator	Timing & pulse generation	SN74121N	21	4
X2,9	SN74123N, Dual Retriggerable One Shot Multivibrator	Timing & Pulse Gen	SN74123N	21	2
Y1	2.00 MHz Crystal ± .005%	Calibration Marks Osc	3-76-0063-12	15	1
C88	90-400pF Mica Trimmer Cap	2 MHz Osc Adj	429	16	1

10-6. Front Panel Components.

M201	0-500ua Edgewise Meter	% REPLY	2-18-0055	5	1
R201, R204	5K Ohm wire wound, Linear taper, 0.5% Linearity	PRF, KW POWER	1-76-0019	4	2

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
R202	Dual 15K Ohm Linear Taper	PULSE WIDTH	1-76-0096		
R205, R212, R213	20K Ohm, Linear Taper	COIN-GATE SLICER ADJ 50us POS	1-76-0021	18	3
R206	30K Ohm, Linear Taper	DBL INTERR	1-76-0073	18	1
R208	10K Ohm, Linear Taper	HET OSC FREQ	1-76-0095	18	1
R209/ R210	100 Ohm, 10K Ohm 10 turn Ass'y Linear Taper	VAR FREQ	1-76-0059	9	1
R211	100 Ohm Reply Gain Ass'y Linear Taper	REPLY GAIN	1-18-0062	9	1
R214	5K Ohm, Linear Taper	CAL Ø	1-76-0045	18	1
S201	1 Pole, 10 throw rotary Switch	PULSE SPACING	1-14-0387	18	1
S202 S214	3 pole, 4 throw rotary Switch	PRF MODE, COUNTER MODE	1-76-0085	18	2
S203	2 pole, Single throw toggle Sw	2us/1us	CK-7103	18	1
S204, S208, S209, S211, S212, S213	1 pole, Single throw toggle Sw	X Ch/Y Ch DBL INTERR ON/OFF, X1/- X10, VAR/ FIXED, HET OSC On/Off MARKER On/Off	CK-7101	18	6

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
S205	3 pole, Single throw toggle Sw	NORM/SQUARE	CK-7301	18	1
S206	2 pole, Single throw toggle Sw	30-60/50-500	CK-7213	18	1
S207	1 pole, Single throw push button switch	PUSH DISPLAY GATE	30-1	6	1
S215	1 pole, Single throw push button switch	PUSH DISPLAY SLICER	30-1	6	1

10-7. Phase Lock Board.

	Phase Lock Bd Ass'y		1-18-0022	9	1
Q301-303	2N3646, NPN	Inverters	2N3646	11	3
Q304, 306, 308, 315, 317, 319, 320	2N3415, NPN	Various Tasks	2N3415	19	8
Q307, 309, 310	2N5462, N-Ch FET	Switch, Buffer	2N5462	13	3
Q312, 313	UC714, N-Ch FET	Switch, Buffer	UC714	14	2

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
Q314	2N5366, PNP	Clamp	2N5366	19	1
Q316	2N3403, NPN	Sample Pulse Formation	2N3903	14	1
Q318	2N2405, NPN	Series-Pass Reg	2N2405	17	1
Q321	2N3905, PNP	Amplifier	2N3905	14	1
X301-303	SN72741L Op Amp	Feedback Amp	SN72741L	21	3
X304	CD4046A Phase Lock Loop System	Course Phase Det	CD4046A	17	1
CR301, 302	1N5240, 1N4740 10V Zener Diode	+10V power Supply	1N5240/ 1N4740	7	2
CR304/ 308	1N4148	Various Tasks	1N4148	19	8

10-8. Power Supply.

T1	110 VAC or 220 VAC Pri., 8 VAC CT and 30 VAC CT Sec	+5 and ± 20V Supply power	2-18-0114	15	1
CR601-606	Varo Diode Bridge	Fullwave rectifier	Varo VS-248 or IFR 1-00-0024	2	2
	Regulator Bd	+20,-20, +5 Voltage Regulators	1-18-0115	9	1

Ref Desg	Name of Part & Description	Circuit Function	IFR Part Number	Mfg Code	Total Ident Parts
Q501, 502, 506, 507,509 510	2N3638, PNP	Amplifier	2N3638	14	6
Q503, 504, 508, 511, 512	2N3415, NPN	Amplifier	2N3415	19	5
Q602, 603	2N3055, NPN	Series Reg	2N3055	17	2
Q601	2N2869, PNP	Series Reg	2N2869	17	1
CR502, 506	1N4735, 6.2V Zener	6.8V Ref source	1N4735	7	1
CR503	1N4740, 10V Zener	10V Ref source	1N4740	7	1
CR504 505	1N4148 Diode	Circuit isolation	1N4148	19	2
CR507	1N4733, 5.1V Zener Diode	5.1V Ref source	1N4733	7	1
	Program Divider Bd Ass'y	Freq Sel in Ø	1-18-0032	9	1
IC 401, 402, 403 404, 405	SN74190	Divider	SN74190	21	5
IC 406, 407	SN7430	Gate	SN7430	21	2
IC 408, 409	SN7400	Gate	SN7400	21	2

CODE	NAME	ADDRESS
1	Addington Labs	1043 DiGiulio Av, Santa Clara, CA 95950
2	Allen Electronics	166 Bellevue St, Elizabeth, NJ 07207
3	Allied Electronics	401 E. 8th, Forth Worth, TX 76102
4	Clarostat c/o Palatine Electronics	7520 W. 63rd St, Suite 10, Overland Park, KS 66202
5	General Electric Company	Suite 518, 911 Main St, Kansas City, MO 64199
6	Grayhill Inc	561 Hillgrave Av, LaGrange, IL 60526
7	Hall Mark Electronics	9006 Rose Hill Road, Lenexa, KS 66215
8	Hewlett Packard	11131 Colorado St., Kansas City, MO 64137
9	Instrument Flight Research	4053 Navajo Lane, Wichita, KS 67210
10	KW Industries Inc	P.O. Box 508, Prague, OK 74864
11	G.S. Marshall Company	9674 E. Telstar Av, El Monte, CA 91731
12	Microwave Filter Co	6743 Kinne St, East Syracuse, NY 13057
13	Motorola	6700 W Squibb, Suite 104, Mission, KS 66202
14	National Semiconductor, Inc	2900 Semiconductor, Santa Clara, CA
15	National Transformer Corp	500 Follis St, Johnston City, IL 62951
16	Parametric Inductries	742 Main St, Winchester, MA 01890
17	RCA Corp	Suite 111, 5750 W 95th, Overland Park, KS 66207
18	Radio Supply	115 Laura, Wichita, KS 67211
19	Solid State Industries, Inc	46 Farrand St, Bloomfield, NJ 07003
20	Solitron Microwave	Indian Town Road, Jupiter, FL 33458
21	Texas Instruments, Inc	Paul Welch Bldg, Suite 205, 3300 S. Dixie Drive, Dayton, OH 75439
22	Kemet Capacitors, Union Carbide Corp	7151 W Gunnison Street, Suite 125, Chicago, IL 60656

ACCOPRESS®

NO. 2507

BF - RED	BY - YELLOW
BG - BLACK	BA - TANGERINE
BD - GREY	BB - ROYAL BLUE
BU - BLUE	BX - EXECUTIVE RED
BP - GREEN	

SPECIFY NO. & COLOR CODE

ACCO CANADIAN COMPANY LTD.
TORONTO CANADA

MP MASTER
MA36010